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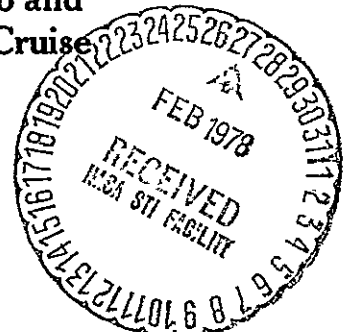
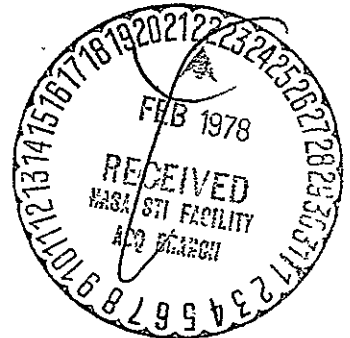
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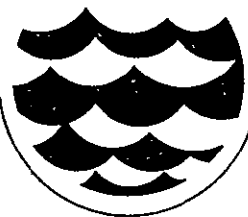
College Station, Texas

Final Report:

Scientific Investigations in the Gulf of Mexico and
Caribbean Sea During the 1974-75 Calypso Cruise

December 1975





CENTER FOR MARINE RESOURCES / Texas A&M University

Sea Grant Program

December 31, 1975

Dr. Warren Hovis
Code 940
NASA/Goddard Space Flight Center
Greenbelt, Md. 20771

Dear Dr. Hovis:

Enclosed are 10 copies of the Final Report for contract NAS5-20877, "Scientific Investigations in the Gulf of Mexico and Caribbean Sea During the 1974-75 Calypso Cruise". We have appreciated the help and encouragement provided by you and your associates during the course of this project.

Dr. El Sayed and Dr. Harlan remain at your disposal for questions concerning the project work or clarification of items in the report. Feel free to contact them directly.

Sincerely yours,

Willis H. Clark
Associate Director

WHC:v1

FINAL REPORT
SCIENTIFIC INVESTIGATIONS IN THE GULF OF MEXICO
AND CARIBBEAN SEA DURING THE 1974-1975 CALYPSO CRUISE

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Contract NAS5-20877
Final Report for the Period November 1974-December 1975

prepared for
NASA/Goddard Space Flight Center
Greenbelt, Maryland 20771
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Warrenton, Virginia 22186

FINAL REPORT

Scientific Investigations in the Gulf of Mexico and Caribbean
Sea During the 1974/75 CALYPSO Cruise

Part I: BIOLOGICAL INVESTIGATIONS OF THE GULF OF MEXICO
 (in connection with the CALYPSO Investigations)

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December 31, 1975

Prepared for:

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BIOLOGICAL INVESTIGATIONS OF THE GULF OF MEXICO
(in connection with the CALYPSO Investigations)

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PART I. BIOLOGICAL INVESTIGATIONS OF THE GULF OF MEXICO
(in connection with the CALYPSO Investigations)

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I. PREFACE

In March, 1975, an Interim Report entitled "Scientific Investigations in the Gulf and Caribbean during the 1974/75 CALYPSO Cruise" was submitted to NASA. The report gave a background information of the study undertaken, and explained in detail how the physical, chemical and biological data were collected during the CALYPSO field operation during the period between November 8, 1974, and February 24, 1975.

At the time the Interim Report was submitted to NASA, CALYPSO field activities were just over and only partial analysis of the data collected was complete. Following the submission of the Interim Report, we have completed the analysis and processing of the physical, chemical and biological data collected during the CALYPSO Cruise. In an effort to meet our contractual responsibilities and to submit this report on time, it was not possible to carry out an in-depth assimilative study of all the physical, chemical and biological data collected. However, in the present report, we have endeavored to present a succinct summary of these data, together with an analysis and interpretation of the results obtained during this investigation.

II. INTRODUCTION

An excellent opportunity to contribute to our knowledge of the use of remote sensing techniques to study the distribution of the phytoplankton standing crop was presented when a team of investigators from the Texas A&M University's Department of Oceanography and the Remote Sensing Center conducted a cooperative study with the NASA scientists. These studies were carried out on board the R/V CALYPSO late last fall and early this year. The investigations were designed to provide basic scientific information for correlating measurements in the Gulf of Mexico with observations from NASA U-2 aircraft equipped with specially designed instruments developed by NASA scientists for the measurement of ocean color phenomena (Hovis, 1975).

During this investigation, the R/V CALYPSO Cruise (November 8, 1974 - February 24, 1975), can be conveniently divided into three legs. The dates, areas investigated and number of stations occupied during each of the three legs are given below:

<u>Leg No.</u>	<u>Area Investigated</u>	<u>Dates</u>	<u>No. of Stations Occupied</u>
I	Eastern & NE Gulf of Mexico	11/8 - 11/21/74	8
II	West & SW of Mississippi Delta	11/26 - 12/13/74	32
III	Yucatan & Florida Straits	2/20 - 2/25/75	9

As was explained in our Interim Report, the selection of the areas investigated was predicated on the need to cover a wide variety of water masses and environmental conditions in order to fully test the capabilities of the newly developed NASA instruments. Thus in Leg I, we were interested in comparing such widely varied environmental conditions as the regions off Tampa Bay, Panama City, Florida, and Timbalier Bay, Louisiana. In Leg II, we were primarily interested in studying the effect of the Mississippi River discharge on the

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distribution of the phytoplankton and on nutrient concentrations in the areas affected by the river plume. In Leg III, on the other hand, we were interested in studying phytoplankton distribution and abundance in the deep-oceanic waters of the Yucatan and Florida Straits (Fig.1).

It should be noted, however, that the NASA U-2 overflights were limited only to three of the eight stations occupied during Leg I. These stations are: Station II (off Tampa Bay, Florida); Station III (off Panama City, Florida) and Station IV (off Timbalier Bay, Louisiana).

Assisting the R/V CALYPSO in collecting the hydrographical and biological data, were two inflatable rubber boats: the Zodiac R (for Right) and Zodiac L (for Left), in relation to the direction of the ship.

III. OBJECTIVES

The objectives of this phytoplankton study are:

- (1) To estimate the standing crop of phytoplankton, in terms of chlorophyll a, at the stations occupied by the R/V CALYPSO and the two Zodiacs.
- (2) To estimate the depths of the euphotic zones at all the CALYPSO and Zodiac stations,
- (3) To study the concentrations of the nutrient salts in the water columns at the stations occupied in the Gulf of Mexico.
- (4) To study the species composition and relative abundance of the phytoplankton in surface water samples collected at the three stations where the U-2 flights took place.
- (5) To compare the data on standing crop of phytoplankton, nutrient salts with the data obtained in other parts of the Gulf of Mexico during previous cruises in the Gulf.

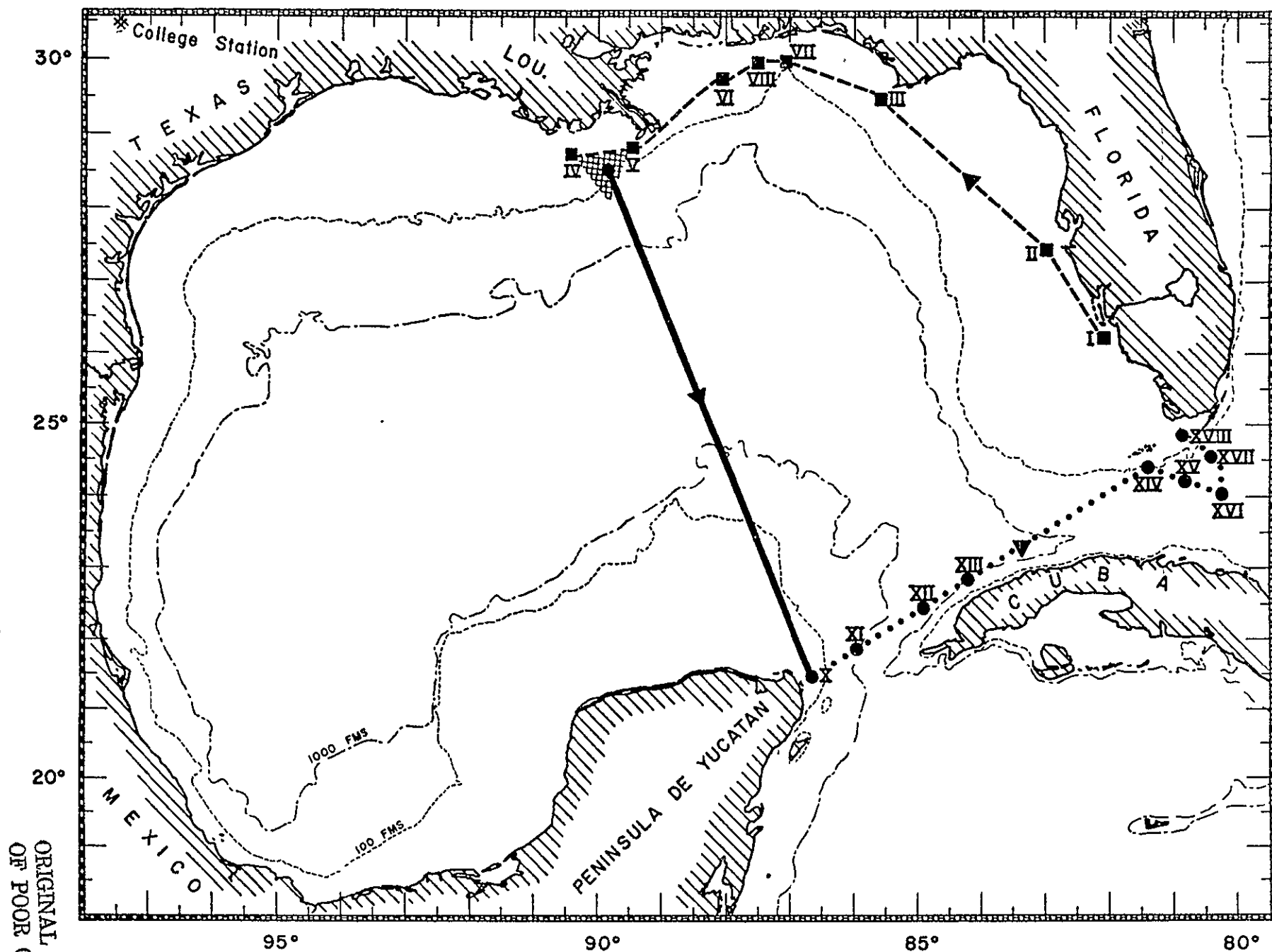


FIG 1. POSITIONS OF STATIONS OCCUPIED BY R/V CALYPSO IN THE GULF OF MEXICO (NOVEMBER 8, 1974 - FEBRUARY 24, 1975). THE MISSISSIPPI RIVER PLUME REGION IS SHOWN BY THE SHADED REGION.

IV. MATERIALS AND METHODS

Sampling Procedure

On arrival at a station, hydrographic and biological data gathering commenced on board the R/V CALYPSO immediately after the two Zodiacs had left the ship. In view of the short distances traveled by the Zodiacs, it is reasonable to assume that the CALYPSO and the Zodiacs' operations were carried out about the same time.

The sampling pattern followed by the CALYPSO and the two Zodiacs in each of the three transects made during Leg I was the same. During these transects the CALYPSO followed a path directly below the U-2 aircraft. The CALYPSO then made three successive stations approximately five miles apart, while the two Zodiacs were dispatched to sample sites occupied at one mile intervals (up to four miles), thus making a total of 27 sites in 80 square miles (see Fig. 2). In this figure, the positions of the CALYPSO are shown by the closed circles at A, B and C. The corresponding positions of the Zodiacs are shown by the triangles. At stations other than those of the U-2 flights, the positions of the A, B and C varied between a few to several miles.

The sampling program on board the CALYPSO consisted of the following:

- (a) Secchi disc readings
- (b) Launching of XBT
- (c) Niskin samplers cast (for salinity, nutrients, chlorophyll and other plant pigments determination)
- (d) Vertical plankton haul.

The sampling operation of the two Zodiacs entailed the following:

- (a) Sea surface temperature
- (b) Secchi disc readings
- (c) Collection of surface water samples for chlorophyll (and other plant pigments) and nutrient determination.

Upon completion of the sampling program, the Zodiac's samples were returned to the CALYPSO within about 45 minutes of the initiation of the operation.

Methods Used

1. Chlorophyll a and Other Plant Pigments

Chlorophyll a, used as a measure of the phytoplankton standing crop, was estimated spectrophotometrically (Richards and Thompson, 1952; Greitz and Richards, 1955) on a Beckman DBG grating spectrophotometer. A measured volume of seawater (usually 2 to 3 liters) was filtered through a 47 mm HA Millipore filter (pore size 0.45 μm). When filtration was complete, the filters were desiccated, then stored in the dark at 1°C. The equations of Strickland and Parsons (1968) were used in determining the concentrations of chlorophylls a, b and c, together with astacin and non-astacin carotenoids.

2. Species Composition of Phytoplankton

Vertical net hauls were made with 35 μm mesh net. Phytoplankton samples were studied by light and electron microscopes (Zeiss phase contrast light microscope and Jeolco JSM-U-3 Scanning Electron Microscope. Diatoms were cleaned using the method of Hasle and Fryxell (1970) and Simonsen (1974), and mounted permanently for light or electron microscopy study.

3. Nutrient Salts Analysis (Phosphates, Silicates and Nitrates)

Water samples were taken from the regular Niskin cast for the determination of silicates, phosphates, and nitrates concentrations. These samples were kept frozen and were later shipped to Texas A&M University.

Nutrient analysis was made using a Technicon Auto-Analyzer following the methods outlined by Strickland and Parsons (1968).

4. Light Penetration

Submarine light penetration was estimated by a 30 cm Secchi disc. Two methods were employed in reading the Secchi disc, one from the 'hero' platform as is standard procedure, and the other involving the use of a face mask to eliminate errors due to refraction and reflection at the air-sea interface. In calculating the depths of the euphotic zone (depth to which 1% of surface light intensity penetrates), only the standard Secchi disc readings were employed. Using semi-log papers, and taking the depths (in m) at which the Secchi disc disappeared as corresponding to about 16% of the surface illumination, we were able to calculate the depths of the euphotic zone.

V. RESULTS

The pertinent physical, chemical and biological data collected during Legs I, II and III of this investigation are given in Tables 1 through 17. In Tables 18, 19, and 20, we have summarized for each of the three legs, the minimum, maximum, average and number of observations for each of the following parameters studied: temperature, salinity, depth of the euphotic zone, chlorophyll a, phosphates, silicates and nitrates for the stations occupied in each leg by the R/V CALYPSO. In Leg I we have included the data collected by the two Zodiacs.

The horizontal and vertical distributions of the parameters studied at the stations/positions occupied during Legs I, II and III will be discussed below.

TABLE 1. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALYPSO AND ZODIACS AT STATION 1 (LEG 1) OFF MUD HOLE.
(November 9, 1974)

Station I	Depth (m)	Time (Local)	Secchi disc		Euphotic Zone Depth(m)	Temp. (°C)	Salinity (‰)	PO ₄ (μg.at/L)	SiO ₃ (μg.at/L)	NO ₃ (μg.at/L)	Total Chlorophyll			Plant Carotenoids (ng/m ³)	Mannoplankton			Plant Carotenoids (ng/m ³)
			dry (m)	wet (m)							a (μg/m ³)	b (μg/m ³)	c (μg/m ³)		a (μg/m ³)	b (ng/m ³)	c (μg/m ³)	
1A																		
26°15-50-N	0	1010	5.0	-	12.6	-	35.024	1.97	6.6	0.25	0.899	0.608	1.928	3.000	0.797	0.488	1.587	2.850
82 01-00-W	5						35.020	1.63	5.8	.10	0.739	0.510	1.610	2.900	.637	.369	1.545	2.750
0800 Local (1300 GMT)																		
Z-R-1		0835	4.5	5.5	11.3	19.6	35.000	1.74	4.8	0.10	0.638	0.391	1.270	2.400	0.529	0.353	1.122	2.100
Z-R-2		0845	4.5	5.5	11.3	23.1	35.026	1.61	8.2	.10	.804	.385	1.668	3.250	.747	.429	1.417	2.900
Z-R-3		0856	5.0	5.5	12.6	23.4	35.018	1.52	9.9	.05	.746	.407	1.692	3.000	.637	.369	1.545	2.750
Z-R-4		0909	5.0	6.0	12.6	23.4	34.997	1.77	7.5	.10	.746	.407	1.692	2.900	.637	.369	1.545	2.700
Z-L-1		830	4.0	5.5	10.0	23.3	35.026	1.75	12.4	0.05	0.906	0.526	1.734	3.350	0.746	0.407	1.692	3.100
Z-L-2		848	5.5	5.3	13.8	23.3	35.000	0.44	2.4	.05	1.160	.825	2.586	4.350	.942	.727	2.566	4.050
Z-L-3		904	6.0	5.5	15.2	23.3	35.114	1.71	13.4	.05	.682	.554	1.358	2.700	.580	.412	1.293	2.550
1-B																		
26°05-5-N	0	1150	4.0	-	10.0	22.7	34.653	2.79	16.8	0.30	1.218	0.803	2.562	3.750	1.022	0.483	1.688	2.950
82 02-5-W	5					22.7	34.652	2.59	16.8	.75	1.059	.728	1.970	3.650	.921	0.386	1.072	3.050
1050 Local																		
Z-R-5		1055	4.0	5.0	10.0	19.5	34.706	2.30	15.2	0.05	1.320	0.945	2.628	4.900	1.110	0.787	2.140	4.100
Z-R-6		1101	3.75	4.0	9.5	19.4	34.763	2.03	11.1	.05	1.371	1.004	2.798	5.250	1.219	0.825	2.287	4.250
Z-R-7		1112	4.0	4.5	10.0	23.2	34.750	2.12	14.9	.05	1.117	.706	1.947	4.150	1.117	.706	1.947	3.800
Z-R-8		1121	5.0	5.25	12.6	23.3	34.731	2.05	14.9	.05	.957	.586	1.904	3.700	0.842	.652	1.676	2.850
Z-L-5		1057	4.0	4.5	10.0	22.8	34.678	2.34	15.5	.05	1.175	0.684	1.924	4.200	.965	.527	1.436	3.300
Z-L-6		1108	4.5	5.0	11.3	23.0	34.784	2.18	16.1	.10	2.017	1.336	3.599	6.200	1.704	1.037	3.046	5.700
Z-L-7		1116	5.0	5.0	12.6	23.1	34.909	2.00	14.2	.05	1.226	.744	2.094	4.300	1.022	.483	1.688	3.400
Z-L-8		1127	6.0	6.0	15.2	23.1	34.980	1.75	11.2	.05	1.269	.885	2.458	4.100	.972	.445	1.242	2.750

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TABLE 2.

PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALYPSO AND ZODIACS AT STATION II (LEG I) OFF TAMPA, FLORIDA

(November 10, 1974)

Station II	Depth (m)	Time (Local)	Secchi disc		Temp. (°C)	Salinity (‰)	PO ₄ (μg.at/L)	SiO ₃ (μg.at/L)	NO ₃ (μg.at/L)	Total Chlorophyll			Plant Carotenoids (mg/m ³)
			dry (m)	wet (m)						a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
II-A													
27°23-0-N	0	0814	9.0	-	22.5	35.181	0.36	0.8	0.0	0.530	0.375	0.848	1.500
82 57-5-W	5				22.5	35.169	0.26	0.4	0.0	.478	.293	.952	1.300
0800 Local (1300 GMT)	10				22.6	35.170	0.31	0.5	0.1	.601	.146	.987	1.450
Z-R-1	0	0805	10.5	11.0	22.4	35.113	0.30	0.4	0	0.581	.435	1.018	1.600
Z-R-2	0	0815	10.5	11.5	22.4	34.999	0.34	0.9	0	.639	.413	.995	1.700
Z-R-3	0	0826	8.5	9.5	22.5	34.896	0.52	0.9	0	.645	.287	1.351	1.800
Z-R-4	0	0836	8.5	9.0	22.4	34.783	0.75	0.9	0	.639	.413	.995	1.600
Z-L-1	0	0804	8.5	9.5	22.4	35.224	0.28	1.3	0	0.539	.271	0.929	2.100
Z-L-2	0	0812	10.25	11.5	22.5	35.279	0.16	1.1	0	0.523	.456	1.041	1.900
Z-L-3	0	0822	10.0	12.25	22.6	35.308	0.17	1.0	0	.530	.375	.848	1.850
Z-L-4	0	0832	10.75	12.75	22.6	35.331	0.32	0.9	0	.588	.353	.824	1.750
II-B													
27°26-5-N	0	1025	10.0	-	22.5	35.276	0.28	1.3	0.1	0.530	.375	0.848	1.600
82 59-3-W	5				22.5	35.285	.21	1.3	0	.755	.369	.948	1.850
1000 Local	10				22.4	35.299	.30	1.9	0.1	.594	.250	.906	1.600
Z-R-5	0	1016	10.0	11.5	22.5	35.222	0.21	1.3	0	0.588	0.353	0.824	1.700
Z-R-6	0	1027	9.5	11.0	22.5	35.205	.25	1.2	0	.653	.250	.608	1.700
Z-R-7	0	1037	9.5	11.5	22.45	35.171	.24	1.5	0	.594	.250	.906	1.650
Z-R-8	0	1046	9.5	11.5	22.45	35.162	.26	1.3	0	.601	.146	.987	1.600
Z-L-5	0	1014	10.25	11.25	22.4	35.281	0.16	1.5	0	0.594	0.228	1.181	1.750
Z-L-6	0	1023	11.50	12.50	22.5	35.302	.16	1.8	0	.536	.249	1.204	1.500
Z-L-7	0	1031	11.50	14.25	22.6	35.307	.18	1.9	0	.478	.293	.952	1.400
Z-L-8	0	1038	11.50	12.75	22.6	35.277	.20	1.9	0.1	.428	.233	.782	1.250
II-C													
27°34.0-N	0	1235	11.0	-	22.5	35.326	0.32	2.9	0.4	0.530	0.375	0.848	1.550
83 02-0-W	5				22.5	35.319	.33	2.5	0.1	.638	.391	1.270	1.500
1202 Local	10				22.4	35.319	.33	2.6	0.1	.697	.391	.971	1.600
Z-R-9	0	1212	10.0	12.0	22.5	35.288	0.27	2.7	0.1	0.536	.249	1.204	1.800
Z-R-10	0	1221	10.5	10.5	22.5	35.240	.36	2.5	0.1	.536	.271	.929	1.700
Z-R-11	0	1229	9.5	11.0	22.4	35.167	.36	2.7	0.2	.485	.190	1.034	1.700
Z-R-12	0	1238	9.5	9.5	22.4	35.115	.42	2.4	0.1	.478	.293	.952	1.850
Z-L-9	0	1209	10.5	11.0	22.5	35.301	0.63	2.2	0.1	0.581	.435	1.018	1.750
Z-L-10	0	1218	9.75	11.5	22.5	35.337	.31	1.9	0.2	.544	.190	.735	1.600
Z-L-11	0	1225	10.0	11.0	22.6	35.325	.22	2.1	0.1	.378	.196	.337	1.000
Z-L-12	0	1233	10.5	11.75	22.6	35.291	.27	1.6	0.1	.421	.337	.700	1.150

TABLE 3. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALYPSO AND ZODIACS AT STATION III (LEG I) OFF PANAMA CITY, FLORIDA
(November 13, 1974)

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Station III	Depth (m)	Time (Local)	Secchi Disc		Temp. (°C)	Salinity (‰)	PO ₄ (μg.at/L)	SiO ₃ (μg.at/L)	NO ₃ (μg.at/L)	Total Chlorophyll			Plant Carotenoids (mg/m ³)
			dry (m)	wet (m)						a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
III-A													
29°32-0-N	0	0901	4.0	5.0	19.8	34.243	0.41	4.1	0.1	0.681	.532	1.633	2.950
85°28-0-W	5	-	-	-	19.9	34.279	.45	4.1	.1	.688	.428	1.715	3.300
0800 Local (1300 GMT)	8	-	-	-	19.9	34.237	.41	3.5	.1	.688	.428	1.715	3.200
Z-R-1	0	0804	5.5	5.75	19.6	34.271	0.39	4.3	0.1	0.891	.667	2.396	4.200
Z-R-2	0	0825	5.25	6.0	19.7	34.254	.42	4.5	.1	.840	.607	2.226	4.200
Z-R-3	0	0835	5.25	6.5	19.6	34.231	.50	5.0	.2	.892	.689	2.121	4.250
Z-R-4	-	0844	5.0	5.0	19.6	33.884	.50	5.6	.3	.747	.429	1.417	3.950
Z-L-1	0	0814	6.75	7.0	20.7	33.585	0.34	3.5	0	0.573	.516	1.211	2.250
Z-L-2	0	0823	8.75	9.25	20.7	33.774	.37	4.2	.1	.573	.516	1.211	2.100
Z-L-3	0	0830	9.00	9.25	20.8	33.961	.40	4.0	0	.581	.435	1.018	1.800
Z-L-4	0	0839	9.25	9.25	20.8	33.400	.45	4.5	.1	.536	.249	1.204	1.600
III-B													
29°34-3-N	0	1053	12.0	14.0	20.8	34.375	0.42	3.7	0	0.485	0.190	1.034	1.700
85°32-7-W	10	-	-	-	21.0	34.353	.38	3.3	0	.428	.233	.782	1.550
1018 Local	15	-	-	-	21.0	34.350	.42	4.2	0.1	.428	.255	.507	1.500
Z-R-5	0	1023	8.5	11.0	21.0	34.312	0.35	3.8	0	0.420	0.315	0.975	1.750
Z-R-6	0	1037	10.0	12.0	21.0	34.338	.36	3.7	0.2	.471	.374	1.146	1.600
Z-R-7	0	1040	10.5	11.0	21.9	34.373	.35	3.7	0	.523	.456	1.041	1.650
Z-R-8	0	1048	9.5	10.5	21.0	34.395	.37	3.3	0	.587	.331	1.099	1.800
Z-L-5	0	1025	13.25	13.5	20.9	34.047	0.38	4.2	0.1	0.536	0.271	0.929	1.400
Z-L-6	0	1034	13.50	12.25	21.1	34.525	.40	4.0	0.1	.594	.250	.906	1.450
Z-L-7	0	1042	12.75	12.0	21.2	34.346	.35	3.3	0.1	.594	.228	1.181	1.650
Z-L-8	0	1049	11.75	12.0	21.3	34.556	.38	3.9	0.1	.587	.309	1.374	1.700
III-C													
29°38-6-N	0	1227	10.0	13.0	21.4	34.525	0.45	3.8	0.5	0.536	0.249	1.204	1.800
85°39-0-W	5	-	-	-	21.5	34.497	.53	3.6	.3	.594	.228	1.181	2.000
1155 Local	10	-	-	-	21.5	34.517	.42	3.8	.2	.587	.331	1.099	2.100
	15	-	-	-	21.4	34.498	.44	3.3	.1	.485	.190	1.034	1.550
Z-R-9	0	1201	11.5	12.0	20.8	34.440	0.38	2.8	0	0.624	0.576	1.382	2.250
Z-R-10	0	1210	11.0	12.25	21.2	34.357	.35	2.8	0	.681	.532	1.633	2.350
Z-R-11	0	1218	11.5	11.5	20.8	34.179	.29	2.8	0	.624	.576	1.382	2.400
Z-R-12	0	1226	9.5	10.0	20.3	34.109	.31	2.6	0.1	.624	.576	1.382	2.550
Z-L-9	0	1203	10.0	10.0	21.2	34.226	0.40	4.2	0.1	0.587	0.309	1.374	1.950
Z-L-10	0	1209	13.0	13.5	21.5	34.422	.38	4.0	.1	.536	.249	1.204	1.750
Z-L-11	0	1213	13.75	14.25	21.5	34.679	.35	3.5	.1	.587	.331	1.099	1.900
Z-L-12	0	1219	11.5	12.0	21.5	34.345	.36	3.6	.1	.587	.331	1.099	2.050

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TABLE 4. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALYPSO AND ZODIACS AT STATION IV (LEG 1) OFF TIMBALIER BAY, LOUISIANA
(November 15, 1974)

Station IV	Depth (m)	Time (Local)	Secchi Disc		Temp. (°C)	Salinity (‰)	PO ₄ (μg.at/L)	SiO ₃ (μg.at/L)	NO ₃ (μg.at/L)	Total Chlorophyll			Plant Carotenoids (mg/m ³)
			dry (m)	wet (m)						a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
IV-A													
28°49-0-N	0	0900	3.0	3.3	21.1	33.464	0.73	4.8	1.6	0.536	0.249	1.204	1.400
90°29-0-W	5	-	-	-	21.1	33.473	.87	5.2	1.7	.427	.211	1.057	1.200
0800 Local (1300 GMT)	10	-	-	-	21.0	33.476	.78	4.5	1.5	.485	.190	1.034	1.050
Z-R-1	0	0817	2.25	2.0	21.1	33.528	0.73	5.4	1.7	0.472	0.397	0.871	1.400
Z-R-2	0	0829	1.75	2.25	21.0	33.592	.52	2.8	.7	.529	.353	1.122	1.400
Z-R-3	0	0844	2.0	2.0	21.2	33.639	.56	3.6	.8	.536	.271	.929	1.450
Z-L-1	0	0812	2.5	2.75	20.9	33.365	0.83	5.8	1.9	0.478	0.293	0.952	1.300
Z-L-2	0	0824	2.0	2.25	20.8	32.702	.78	5.1	1.8	.421	.337	.700	1.250
Z-L-3	0	0833	1.5	2.50	20.6	32.688	.91	6.3	2.4	.588	.353	.824	1.550
IV-B													
28°43-0-N	0	1038	4.0	4.5	21.1	33.829	0.48	2.3	1.0	0.536	0.249	1.204	1.350
90°26-0-W	5	-	-	-	21.1	33.814	.61	3.8	1.0	.652	.228	.883	1.450
1008 Local	10	-	-	-	20.0	33.828	.67	4.1	1.2	.601	.146	.987	1.300
Z-R-5	0	1017	4.0	4.5	21.4	33.906	0.59	4.5	1.0	0.420	0.315	0.975	1.400
Z-R-6	0	1029	3.25	3.75	21.5	34.092	.53	3.0	.6	.478	.271	1.227	1.450
Z-R-7	0	1042	4.25	5.0	21.5	34.286	.50	4.2	.7	.536	.271	.929	1.450
Z-L-5	0	1015	3.75	4.75	21.1	33.757	0.59	3.8	0.8	0.645	0.309	1.076	1.450
Z-L-6	0	1024	3.75	3.75	21.0	33.527	.67	4.9	1.2	.594	.250	.906	1.500
Z-L-7	0	1034	3.50	3.5	21.0	32.805	.61	4.3	1.2	.652	.206	1.158	1.600
IV-C													
28°39-0-N	0	1223	5.0	6.0	21.9	34.461	0.42	2.7	0.6	0.594	0.228	1.181	1.500
90°24-0-W	5	-	-	-	22.0	34.465	.52	3.3	.7	.594	.250	.906	1.400
1200 Local	10	-	-	-	22.1	34.458	.45	3.5	.7	.543	.168	1.010	1.350
Z-R-9	0	1211	4.0	4.5	21.9	34.503	0.46	3.6	0.8	0.587	0.331	1.099	1.450
Z-R-10	0	1223	4.5	5.0	21.9	34.480	.51	4.1	1.0	.587	.309	1.374	1.550
Z-R-11	0	1234	4.5	5.0	22.0	34.536	.47	3.8	1.0	.651	.184	1.433	1.500
Z-L-9	0	1210	4.0	5.0	21.5	33.696	0.45	4.0	0.7	0.536	0.249	1.204	1.550
Z-L-10	0	1219	5.0	5.0	21.6	33.984	.52	4.0	1.0	.594	.250	.906	1.350
Z-L-11	0	1226	5.0	5.25	21.5	33.598	.51	3.9	0.8	.601	.146	.987	1.400

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TABLE 5. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALYPSO AND ZODIACS AT STATION V (LEG 1) OFF MISSISSIPPI RIVER PLUME S.W.
(November 17, 1974)

Station V	Depth (m)	Time (Local)	Secchi disc		Euphotic Zone Depth(m)	Temp. (°C)	Salinity (‰)	PO ₄ (μg.at/L)	SiO ₃ (μg.at/L)	NO ₃ (μg.at/L)	Total Chlorophyll			Plant Carotenoids (mg/m ³)	Nannoplankton			Plant Carotenoids (mg/m ³)
			dry (m)	wet (m)							a (mg/m ³)	b (mg/m ³)	c (mg/m ³)		a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
28°54-6-N 89 29-7-W 0747 Local (1247 GMT)	V-A																	
	0	0820	0.6	1.2	1.52	20.6	24.215	3.84	25.8	17.0	0.768	0.185	0.836	2.100	0.666	0.021	1.046	2.000
	5					20.6	30.301	2.32	13.6	9.2	.652	.228	.883	1.800	.551	.109	.542	1.600
	10					20.7	31.834	1.31	7.5	4.25	.536	.271	.929	1.400	.435	.152	.588	1.300
	Z-R-1	0748	0.75	0.75	1.90	19.6	20.655	4.12	28.3	18.7	1.188	0.455	2.362	3.900	0.985	0.216	1.680	2.500
	Z-R-2	0755	0.5	0.75	1.26	19.6	21.068	3.15	23.7	11.7	1.189	.499	1.812	3.600	.971	.423	1.517	2.400
	Z-R-3	0801	0.5	0.75	1.26	19.6	21.819	4.03	28.8	18.7	1.087	.380	1.471	3.100	.870	.304	1.177	2.280
	Z-L-1	0752	1.0	1.0	2.52	19.4	20.184	2.42	16.0	11.1	1.217	.130	1.588	2.800	0.883	0.097	1.340	2.400
	Z-L-2	0759	0.75	1.0	1.90	19.4	20.742	4.73	33.2	21.4	1.102	.217	1.084	2.800	.884	.141	.790	2.300
	Z-L-3	0804	0.75	1.0	1.90	19.5	21.898	4.52	30.4	20.0	.884	.141	.790	2.300	.783	.022	.449	2.000
28°53-0-N 89 27-3-W (0903 Local)	V-B																	
	0	-	-	-		21.0	24.373	3.5	25.8	16.5	0.999	0.054	1.293	2.400	0.998	0	0.953	2.200
	5					21.5	31.809	1.4	8.7	5.2	.551	.109	.542	1.500	.435	0.152	.588	1.400
	10					22.0	32.686	1.07	6.2	3.6	.435	.152	.588	1.400	.319	.195	.635	1.300
	15					22.2	32.940	.92	5.8	3.3	.550	.064	1.092	1.500	.435	.152	.588	1.400
	Z-R-5	0905	0.75	0.75	1.90	19.9	18.230	3.43	25.4	16.8	1.189	.499	1.812	3.300	1.087	0.380	1.471	3.000
	Z-R-6	0912	0.75	0.5	1.90	19.6	16.336	5.06	32.6	28.9	.986	.261	1.130	2.700	.884	.141	.750	2.400
	Z-L-5	0908	0.5	0.75	1.26	19.2	18.125	4.4	32.2	22.5	1.217	0.130	1.588	2.600	0.999	0.054	1.293	2.200
	Z-L-6	0919	0.5	0.5	1.26	19.1	8.821	5.06	28.0	40.	1.203	.337	1.425	3.100	.986	.261	1.130	2.300
	28°49-27-N 89 23-35-W (1528 Local)	V-C																
0		1605	4.3	5.0	10.8	21.6	31.772	1.41	8.8	5.6	0.985	0.216	1.680	2.500	0.883	0.097	1.340	2.300
5						21.8	31.854	1.33	8.7	5.0	.767	.140	1.386	2.300	.667	.065	.496	2.100
10						22.0	32.864	.84	6.1	2.6	.652	.228	.883	2.200	.551	.109	.542	2.000
15						21.5	33.033	.81	5.4	2.4	.652	.228	.883	2.000	.551	.109	.542	1.700
Z-R-9		1529	5.0	5.5	12.6	19.5	31.921	1.17	7.3	3.8	0.986	.261	1.130	3.000	0.884	0.141	0.790	2.500
Z-R-10		1538	4.5	4.75	11.3	19.6	30.877	1.57	10.9	5.9	1.086	.336	2.021	3.500	.985	.216	1.680	2.700
Z-R-11		1544	3.25	3.5	8.2	19.6	26.809	2.23	15.9	9.7	1.087	.380	1.471	3.300	.986	.261	1.130	2.600
Z-L-9		1533	4.0	7.5	10.0	21.8	32.565	1.01	6.7	3.4	0.986	0.261	1.130	2.500	0.884	0.141	0.790	2.100
Z-L-10		1543	5.25	6.5	13.1	21.9	33.087	.84	5.2	2.5	0.652	.228	.883	2.000	.551	.109	.542	1.700
Z-L-11		1552	5.75	6.0	14.4	21.8	33.018	.88	6.2	2.9	.883	.097	1.340	2.300	.782	0.	.999	2.000

TABLE 6. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD OBTAINED ON BOARD R/V CALYPSO AND ZODIACS AT STATION VI (LEG I) OFF MOBILE BAY
(November 18, 1974)

Station VI	Depth (m)	Time (Local)	Secchi disc		Euphotic Zone Depth (m)	Temp. (°C)	Salinity (‰)	PO ₄ (μg.at/L)	SiO ₃ (μg.at/L)	NO ₃ (μg.at/L)	Total Chlorophyll			Plant Carotenoids (μg/m ³)	Nannoplankton			Plant Carotenoids (μg/m ³)
			dry (m)	wet (m)							a (μg/m ³)	b (μg/m ³)	c (μg/m ³)		a (μg/m ³)	b (μg/m ³)	c (μg/m ³)	
29°52-5-N 88°04-0-W 0820 Local (1320 GMT)	VI-A																	
	0	0900	14.0	22.0	35.0	21.1	34.640	0.32	3.5	0.15	0.217	0.076	0.294	0.850	0.159	0.098	0.317	0.800
	5					21.3	34.472	.32	3.3	.10	.275	.032	.546	1.000	.217	.054	.569	450
	10					21.3	34.481	.29	3.3	.10	.275	.032	.546	1.000	.217	.054	.569	1 000
	20					21.4	34.483	.38	3.9	.10	.326	.092	.716	1.150	.268	.136	.464	1 100
	Z-R-1	0822	16.5	18.0	41.5	20.9	34.460	0.29	3.2	0.05	0.326	0.326	0.716	1.200	0.275	0.032	0.546	1 050
	Z-R-2	0831	13.0	17.5	32.8	20.8	34.410	.28	3.2	0	.376	.152	.887	1.250	.326	.114	.441	1 150
	Z-R-3	0844	15.0	19.5	38.0	20.6	34.464	.29	3.1	0	.434	.130	.863	1.400	.384	.070	.693	1.300
	Z-R-4	0852	16.0	21.0	40.2	20.4	34.403	.27	3.0	0.05	.434	.130	.863	1.250	.384	.070	.693	1.300
	Z-L-1	0824	20.0	22.25	50.4	20.7	34.429	0.35	3.2	0.10	0.326	0.092	0.716	1.050	0.275	0.032	0.546	1.000
	Z-L-2	0834	19.5	22.5	49.0	20.7	34.443	.34	3.5	0.05	.217	.076	.294	.900	.159	.098	.317	.800
	Z-L-3	0843	17.75	20.75	44.0	20.8	34.430	.34	3.0	0.10	.275	.032	.546	1.000	.217	.076	.294	.900
	Z-L-4	0854	17.75	20.25	44.0	20.25	34.406	.34	3.4	0	.384	.070	.693	1.200	.275	.032	.564	1 100
29°57-5-N 88 03-2-W 1011 Local	VI-B																	
	0	1050	17.0	22.2	42.6	20.8	34.194	0.29	3.2	0.10	0.326	0.092	0.716	1 000	0.275	0.032	0.546	0 900
	5					20.8	34.173	.30	3.2	0	.333	.010	.523	1.050	.275	.054	.271	950
	10					20.8	34.221	.29	3.2	0	.434	.130	.863	1.150	.326	.114	.441	1.100
	20					21.0	34.522	.34	3.7	0	.333	.010	.523	1.000	.275	.054	.271	950
	Z-R-5	1013	20.5	23.0	52.0	20.4	34.313	0.29	3.2	0	0.326	.092	.716	1.200	0.275	0.032	0.546	1 100
	Z-R-6	1022	18.0	22.0	45.0	20.4	34.306	.32	3.1	0.10	.434	.130	.863	1.300	.326	.114	.441	1 150
	Z-R-7	1030	19.0	23.0	48.0	20.3	34.244	.27	2.8	0	.434	.130	.863	1.350	.326	.092	.716	1 200
	Z-R-8	1038	17.0	20.0	42.6	20.4	34.230	.27	2.9	0	.428	.233	.782	1.400	.377	.174	.612	1 300
	Z-L-5	1014	18.5	19.25	46.4	19.9	34.067	0.30	3.2	0	0.434	0.130	0.863	1.050	0.326	0.092	0.716	1 000
	Z-L-6	1022	19.5	20.0	49.0	18.8	33.977	.32	3.3	0	.333	.010	.523	1.100	.217	.076	.294	1 050
	Z-L-7	1029	20.25	21.0	51.0	19.7	33.948	.32	3.2	1.9	.333	.010	.523	1.050	.217	.076	.294	1 000
	Z-L-8	1037	22.0	23.0	55.2	19.7	34.057	.35	3.3	.05	.275	.054	.271	0.900	.159	.098	.317	800
30°02-5-N 88 03-6-W 1210 Local	VI-C																	
	0	1305	15.0	18.3	38.0	21.1	34.316	0.28	2.3	0.10	0.384	0.070	0.693	1.200	0.326	0.114	0.441	1 050
	5					21.6	34.300	.27	2.7	.10	.384	.070	.693	1.300	.326	.114	.441	1 200
	10					21.5	34.304	.31	2.5	.05	.492	.108	.840	1 550	.384	.070	.693	1 400
	20					21.5	34.320	.27	2.8	.05	.543	.168	1.010	1 950	.434	.130	.863	1 750
	Z-R-9	1209	15.0	18.0	38.0	20.1	34.267	.25	2.7	0	0.326	0.092	0.092	1.150	0.275	0.032	0.546	1 050
	Z-R-10	1218	14.0	16.0	35.0	20.3	34.338	.32	1.9	0	.326	.092	.716	1.150	.275	.032	.546	1 050
	Z-R-11	1227	16.0	18.0	40.2	20.3	34.292	.25	2.5	0	.384	.070	.693	1.200	.333	.010	.523	1 150
	Z-R-12	1236	15.3	18.0	39.0	20.4	34.303	.35	2.6	.10	.333	.010	.523	1.100	.275	.054	.271	1 000
	Z-L-9	1214	13.5	14.0	34.0	19.9	34.317	0.30	2.6	0	0.384	0.070	0.693	1.200	0.333	0.010	0.523	1 100
	Z-L-10	1223	13.5	15.0	34.0	19.8	34.258	.29	2.6	0	.384	.384	.070	1.200	.333	.033	.248	1 150
	Z-L-11	1230	12.25	15.25	30.6	19.9	34.165	.25	2.2	0	.434	.130	.863	1.250	.384	.070	.693	1 200
	Z-L-12	1237	14.0	14.75	35.0	19.6	34.110	.24	2.3	0	.384	.070	.693	1.150	.333	.033	.248	1 050

TABLE 7. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALYPSO AND ZODIACS AT STATION VII (LEG I) OFF DESOTO CANYON.
(November 19, 1974)

Station VII	Depth (m)	Time (Local)	Secchi disc		Euphotic Zone Depth (m)	Temp. (°C)	Salinity (o/oo)	PO ₄ (μg.at/L)	SiO ₃ (μg.at/L)	NO ₃ (μg.at/L)	Total Chlorophyll			Plant Carotenoids (mg/m ³)	Nannoplankton			Plant Carotenoid (mg/m ³)
			dry (m)	wet (m)							a (mg/m ³)	b (mg/m ³)	c (mg/m ³)		a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
VII-A																		
30°09-5-N	0	1203	20.0	25.0	50.4	21.95	35.384	0.32	2.2	0.2	0.268	0.114	0.739	1.050	0.217	0.054	0.950	0.950
86 58-0-W	5					21.9	35.378	.31	2.3	.1	.325	.070	.991	1.100	.275	.032	0.546	1.000
1105 Local	10					21.8	35.421	.28	2.2	.1	.376	.129	1.162	1.300	.326	.092	.716	1.150
(1605 GMT)	20					21.9	35.495	.29	2.5	.1	.376	.152	.887	1.100	.326	.092	.716	1.050
VII-B																		
30°03-8-N	0	1350	18.0	27.8	45.0	23.6	36.009	0.18	1.3	0	0.217	0.054	0.569	0.650	0.159	0.098	0.317	0.550
86 59-0-W	5					23.5	36.007	.15	1.3	0	.275	.032	.546	.750	.217	.076	.294	.650
1305 Local	10					23.4	36.020	.18	1.3	0	.217	.054	.569	.700	.159	.098	.317	.600
	20					23.4	36.012	.25	1.4	0	.217	.054	.569	.700	.159	.098	.317	.600
	50					23.5	36.082	.20	1.6	0.1	.217	.054	.569	.750	.159	.098	.317	.600
VII-C																		
30°00-0-N	0	1622	30.0*	28.75	76.0	23.4	35.990	0.17	1.5	0.05	0.275	0.032	0.546	0.700	0.217	0.076	0.294	0.650
86 51-0-W	5					23.5	35.978	.23	.7	0	.275	.032	.546	.700	.217	.076	.294	.650
1510 Local	10					23.5	36.003	.21	1.3	0	.217	.076	.294	.700	.159	.098	.317	.650
	20					23.4	36.009	.17	1.5	0	.333	.010	.323	.850	.275	.054	.271	.750
	50					23.5	36.081	.24	1.2	0	.275	.032	.546	.800	.217	.076	.294	.700
	75					23.5	36.103	.17	1.7	0.3	.275	.032	.546	.600	.217	.076	.294	.700
	100					21.0	36.342	.98	5.0	9.0	.217	.054	.569	.690	.159	.098	.317	.600

* Due to air bubbles on the fan tail, this reading was almost impossible with the mask, these bubbles cut the visibility under the water.

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TABLE 8. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALYPSO AND ZODIACS AT STATION VIII (LEG 1) OFF PERSACOLA.
(November 20, 1975)

Station VIII	Depth (m)	Time (Local)	Secchi disc		Euphotic Zone Depth (m)	Temp. (°C)	Salinity (‰)	PO ₄ (μg.at/L)	SiO ₂ (μg.at/L)	NO ₃ (μg.at/L)	Total Chlorophyll			Plant Carotenoids (mg/m ³)	Nannoplankton			Plant Carotenoids (mg/m ³)
			dry (m)	wet (m)							a (mg/m ³)	b (mg/m ³)	c (mg/m ³)		a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
30°13-2-N 87 14-2-W 0802 Local (1302 GMT)	VIII-A																	
	0	0835	10.0	14.6	25.3	20.0	33.657	0.28	1.7	2.0	0.434	0.130	0.863	1.250	0.326	0.092	0.716	1.200
	Z-R-2	0817	8.5	10.5	21.2	19.6	32.817	.20	1.4	0	.492	.108	.840	1.500	.384	.070	.693	1.350
	Z-R-4	0832	8.5	10.0	21.2	19.6	33.079	.21	1.9	0	.492	.108	.840	1.700	.384	.070	.693	1.500
	Z-L-2	0815	15.5	16.5		19.6	34.520	.17	2.0	0	.384	.070	.693	1.250	0.333	0.033	0.248	1.150
30°11-5-N 87 19-2-W (1054 Local)	VIII-B																	
	0	1150	11.4	12.3	28.6	20.4	34.562	0.31	1.8	0.10	0.543	0.160	0.010	1.700	0.434	0.130	0.863	1.600
	Z-R-6	1101	9.4	11.5	22.4	19.4	33.455	.24	0.9	0	0.442	0.049	0.670	1.350	0.333	0.033	0.248	1.250
	Z-R-8	1142	8.5	10.0	21.2	19.4	33.458	.17	1.1	0	.492	.108	.840	1.500	.384	.092	.418	1.400
	Z-L-6	1050	14.5	15.0	36.5	19.4	34.543	.22	2.3	0	0.333	.010	.523	1.100	0.275	0.054	0.271	1.000
	Z-L-8	1119	13.5	14.25	34.0	19.5	34.546	.24	2.2	0	.326	.092	.716	1.200	.275	.032	.546	1.100
30°10-8-N 87 25-5-W (1315 Local)	VIII-C																	
	0	1402	10.0	12.0	25.3	20.8	34.602	0.23	0.8	0	0.442	0.049	0.670	1.350	0.391	0.011	0.225	1.250
	Z-R-10	1326	10.0	12.0	25.3	19.5	34.031	.15	1.5	0	0.442	0.049	0.670	1.400	0.391	0.011	0.225	1.250
	Z-R-12	1341	7.75	9.0	19.7	19.4	33.034	.15	1.1	0	.492	.108	.840	1.500	.442	.048	.670	1.350
	Z-L-12	1333	11.75	14.0	29.5	19.4	34.658	.19	2.7	0	.384	.070	.693	1.200	0.333	0.010	0.523	1.050
	Z-L-12	1333	12.75	15.0	34.5	19.5	34.650	.21	2.7	0	.384	.070	.693	1.200	.333	.010	.523	1.100

TABLE 9 PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALYPSO AT STATIONS A-C, 1 - III (LEG II) OFF MISSISSIPPI

Station Position	#	Date 1974	Depth (m)	Time Local	Secchi disc		Euphotic Zone Depth (m)	Temp. (°C)	Salinity (o/oo)	PO ₄ (μg at/L)	SiO ₃ (μg at/L)	NO ₃ (μg at/L)	Total Chlorophyll			Plant Carotenoids (mg/m ³)	Nannoplankton			Plant Carotenoids (mg/m ³)
					dry (m)	wet (m)							a (mg/m ³)	b (mg/m ³)	c (mg/m ³)		a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
30°05-3-N 87 17-5-W 2110 Local (0310 GMT)	A	26 Nov	0 5 10 20	2130				19.4 20.0 20.4 21.0	34.990 33.524 34.998 34.990	0.19 .29 .25 .19	1.7 1.7 1.7 1.7	0.2 .3 .1 .1	0.639 749 .805 .863	0.413 .495 .429 .385	0.995 592 1.118 1.370	1.400 1.450 1.600 1.550	0.486 492 377 435	0.212 108 174 152	0.759 .840 .612 .588	0.750 .850 .650 .800
30°04-0-N 88 21-3-W 0256 Local (0856 GMT)	B	27 Nov	0 5 10 15	0300				17.8 19.5 20.3 20.6	33.531 34.997 33.513 35.540	0.30 .34 .30 .39	2.3 2.2 2.2 2.0	0.1 05 0 0	0.747 863 .754 .979	0.451 .385 .347 .342	1.142 1.370 1.223 1.324	1.400 1.600 1.300 1.700	0.536 .594 391 486	0.271 .250 0 234	0.929 906 500 484	0.800 950 650 .800
29°25-45-N 88 33-30-W 1139 Local (1739 GMT)	C	27 Nov	0 5 10 20 30 40	1305	9.5	8.5	24.0	20.7 22.0 22.2 22.3 22.7 22.7	33.486 33.451 33.564 34.624 35.143 36.077	0.85 .81 .72 .63 .56 .84	5.0 4.9 4.7 3.7 2.6 4.3	2.0 1.6 1.6 1.6 1.4 3.9	1.319 1.428 1.203 1.087 863 755	0.293 .309 .314 380 .385 369	1.378 1.800 1.700 1.471 1.370 0.948	2.400 2.500 2.300 1.700 1.600 1.600	0.878 .891 1.103 0.551 .500 333	0.245 038 239 1.109 049 010	0.708 871 809 542 372 .523	1.050 1.200 1.300 0.700 700 800
28°48-8-N 89 23-4-W 1620 Local (2220 GMT)	1	9 Dec	0 5 10 20 50	1650	2.5		6.3	17.5 18.5 19.2 21.8 21.0	29.325 29.684 32.384 35.416 35.759	0.88 .21 .27 .08 .36	18.9 3.2 3.8 0.1 3.1	10.9 2.5 2.5 0.4 4.0	1.319 1.429 1.095 0.768 .544	0.293 .353 321 .185 .212	1.378 1.250 1.003 0.836 .461	2.000 2.000 1.800 1.300 1.200	1.110 1.066 783 .449 .275	0.158 017 022 0 0.054	0.616 252 449 476 271	1.000 .950 .800 .550 .500
1502 Local (2102 GMT)	2	9 Dec	0 5 10 20	1540	2.5		6.3	17.1 18.2 19.0 21.6	28.108 29.377 32.525 35.486	1.16 .88 .84 .25	22.3 19.2 11.0 1.0	13.2 11.8 7.1 1.0	1.319 1.095 0.646 .602	0.271 .299 .331 .168	1.653 1.277 .801 .712	2.000 1.700 1.400 1.500	1.226 0.776 500 .275	0.114 125 049 054	0.569 368 372 271	1.250 0.800 .600 500
29°53-0-N 89 27-2-W 1320 Local (1920 GMT)	3	9 Dec	0 5 10 15	1425	0.5		1.26	19.6 20.0 20.5 21.2	21.786 27.441 31.747 35.006	2.77 0.89 .55	42.8 5.6 14.3 6.6	25.2 9.5 4.8	1.388 1.370 0.805 .863	0.605 .331 .429 .385	2.168 1.823 1.118 1.370	2.286 1.900 1.400 1.500	1.109 1.008 0.333 .275	0.179 .038 .010 .054	0.525 275 .523 .271	1.286 1.000 0.550 .500

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TABLE 10. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALYPSO AT STATIONS IV - IX (LEG II) OFF MISSISSIPPI

Station Position	#	Date 1974	Depth (m)	Time Local	Secchi disc		Euphotic Zone Depth (m)	Temp (°C)	Salinity (‰)	PO ₄ (μg-at/L)	SiO ₃ (μg-at/L)	NO ₃ (μg-at/L)	Total Chlorophyll			Plant Carotenoids (mg/m ³)	Nannoplankton			Plant Carotenoids (mg/m ³)
					dry (m)	wet (m)							a (mg/m ³)	b (mg/m ³)	c (mg/m ³)		a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
29°54-8-N 89 29-0-W 0930 Local (1530 GMT)	4	9 Dec	0 5 10 20	1230	0.5		1.26	19.6 20.2 20.8 21.9	31.735 32.740 29.178 35.172	1.25 1.17 0.88 0.47	14.3 21.0 12.6 5.8	12.2 11.8 8.6 4.1	1.088 1.538 0.805 486	0.402 .391 .429 234	1.196 1.397 1.118 484	1.600 1.900 1.300 1.100	0.783 950 500 217	0.022 0.060 0.049 0.076	0.449 298 372 294	0.750 1.100 700 350
28°52-30-N 89 38-30-W 1402 Local (2002 GMT)	5	29 Nov	0 5 10 20 50	1450	25.0		63.0	19.2 21.0 22.1 22.6 23.4	27.345 29.208 23.177 33.926 35.792	0.57 .45 .26 .14 .04	23.8 18.6 7.8 4.8 1.6	12.0 9.5 4.1 1.6 0.1	1.219 1.551 486 544 492	0.196 206 234 1.900 .108	0.763 1.285 .484 .735 840	1.600 1.700 1.000 1.300 1.450	0.899 616 0 217 217	0 0 0.098 0.076 .076	0.403 600 0.317 294 294	1.000 0.500 0.300 0.500 0.500
28°50-9-N 89-36-5-W 0634 Local (1234 GMT)	6 (=5R)	30 Nov	0 5 10 20	0555	6.0		15.2	19.6 21.7 21.8 22.7	32.990 33.071 33.173 35.207	0.25 .18 .25 .08	8.2 4.0 7.7 2.8	9.7 2.8 4.2 0.7	0.884 935 769 826	0.119 .201 207 .163	1.065 0.960 .561 813	1.400 1.200 1.100 1.500	0.601 .660 550 .384	0.601 147 086 092	0.146 689 817 418	0.800 600 800 800
29°49-3-N 89-37-1-W 0745 Local (1345 GMT)	7 (=6)	30 Nov	0 5 10 20	0800	12.0		30.0	21.8 22.2 22.9 23.4	34.178 34.139 35.417 35.789	0.16 .15 .07 .03	4.2 5.2 1.8 1.1	8.9 9.3 0.5 0.1	0.820 .877 544 .537	266 .233 .190 .293	732 .983 .735 654	1.400 1.300 0.700 .800	0.558 558 333 275	0.005 0.027 0.010 0.032	0.624 348 523 546	0.800 700 600 700
28°46-45-N 89-36-30-W 1003 Local (1603 GMT)	7 (=7)	30 Nov	0 5 10 20	1015				20.1 21.5 23.5 23.5	35.842 35.804 35.806 35.807	0.08 .03 .03 .03	1.4 1.3 1.3 1.3	0.3 0 0.05 0	0.601 .666 608 .710	0.146 .043 .065 .134	0.987 771 .794 1.134	1.400 1.200 1.300 1.500	0.275 .333 275 384	0.054 0.032 0.054 0.092	0.271 248 271 418	0.500 800 500 500
28°44-30-N 89-34-30-W 0850 Local (1450 GMT)	8	30 Nov	0 5 10 20	0930	18.0		45.0	23.1 23.6 23.6 23.6	35.815 35.788 35.780 35.789	0.02 .01 0 .01	0.1 1.1 4 1.1	0.1 0.1 0 0.1	0.442 .492 .376 .377	0.048 .108 .152 .174	0.670 .640 .887 .612	0.750 800 .750 .700	0.275 .275 .217 217	0.032 0.032 0.076 0.076	0.546 546 294 294	0.500 500 500 500
28°38-0-N 89-40-0-W 1135 Local (1735 GMT)	9	29 Nov	0 5 10 20 50	1210	23.0		58.0	22.4 23.6 23.6 23.6 23.6	35.769 35.748 35.756 35.755 35.747	0.02 0 0 0 0	1.1 1.1 1.2 1.1 1.1	0.2 0 0 0 0	0.486 428 537 486 .595	0.212 .255 .293 .234 .272	0.759 .507 .654 .484 .631	1.250 1.000 1.300 1.200 1.400	0.275 275 .384 .333 .377	0.054 0.032 0.070 0.010 0.174	0.271 546 693 523 612	0.550 600 800 700 600

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TABLE 11. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALIPSO AT STATIONS IX - XII (LEG II) OFF MISSISSIPPI.

Station Position	#	Date 1974	Depth (m)	Time Local	Secchi disc		Euphotic Zone Depth (m)	Temp. (°C)	Salinity (‰)	PO ₄ (μg-at/L)	SiO ₃ (μg-at/L)	NO ₃ (μg-at/L)	Total Chlorophyll			Plant Carotenoids (mg/m ³)	Nannoplankton			Plant Carotenoids (mg/m ³)
					dry (m)	wet (m)							a (mg/m ³)	b (mg/m ³)	c (mg/m ³)		a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
28°27'-4-N 89°41'-0-W 1142 Local (1742 GMT)	9-R	10 Dec	0 5 10 20 50	1208	18.0	17.0	45.0	19.2 20.7 20.7 21.6 22.2	35.015 35.058 35.267 35.693 35.913	0.11 .16 .21 .03 .04	3.5 1.4 2.2 1.3 1.1	1.4 1.1 1.0 0.5 0.6	0.871 .653 .705 .653 .544	0.348 .250 .332 .250 .212	0.627 .608 .503 .608 .461	1.900 1.700 1.800 1.650 1.500	0.602 .486 .544 .384 .275	0.168 .234 .212 .092 .054	0.712 .484 .461 .418 .271	0.950 .900 .900 .600 .500
28°42'-0-N 89°45'-5-W 0945 Local (1545 GMT)	10	29 Nov	0 5 10 20 50	1030	24.5		62.0	22.8 23.6 23.6 23.6 23.7	35.882 35.817 35.824 35.826 35.848	0.01 0 0 .01 0	1.1 1.0 0.9 1.2 1.3	0.2 0 0 0.1 0.1	0.544 .551 .653 .544 .544	0.212 .109 .250 .212 .212	0.461 .542 .608 .461 .461	1.400 1.200 1.600 1.400 1.100	0.275 .275 .384 .327 .269	0.054 .054 .092 .136 .158	0.271 .271 .418 .166 .189	0.600 .550 .600 .750 .600
28°42'-0-N 89°45'-0-W 1320 Local (1920 GMT)	10-R	10 Dec	0 5 10 20 50	1345	12.0	11.0	30.0	19.0 19.8 19.9 21.4 22.0	34.235 34.260 34.457 35.416 35.924	0.27 .25 .25 .02 .02	5.8 4.5 4.5 1.6 1.1	3.1 2.7 2.7 0.5 0.6	1.095 0.985 1.095 0.819 .544	0.299 .238 .299 .244 .212	1.277 1.405 1.277 1.006 .461	2.000 2.050 2.100 1.900 1.700	0.711 .768 1.145 0.434 .378	0.228 .185 .358 .130 .196	0.584 .836 1.448 863 .337	1.050 1.300 1.600 0.750 750
28°46'-5-N 89°48'-0-W 0805 Local (1405 GMT)	11	29 Nov	0 5 10 20	0845				22.5 23.2 23.3 23.3	35.933 35.841 35.858 35.803	0.04 0.01 0.01 0.01	1.5 1.4 1.4 1.4	0.3 0.3 0.1 0.1	0.652 .601 .666 .536	0.206 .146 .043 271	1.158 .987 .771 .929	1.150 1.300 1.200 1.400	0.544 .544 .609 .434	0.190 .190 .087 .130	0.735 .735 .519 .863	1.050 1.200 1.150 1.150
28°46'-F-N 89°48'-3-W 1421 Local (2021 GMT)	11-R	10 Dec	0 5 10 20	1445	9.0	10.0	22.4	19.0 19.3 19.5 21.2	33.464 33.459 34.296 35.326	0.42 .30 .23 .08	5.5 5.5 2.9 1.6	3.0 3.3 1.6 0.7	1.101 1.044 0.892 .609	0.195 .239 0.60 .087	1.359 1.107 0.596 .519	1.400 1.500 1.300 0.950	0.986 .935 .666 .551	0.986 .179 .043 .109	0.261 1.235 0.771 .542	1.250 1.200 1.000 0.900
28°52'-5-N 89°52'-6-W 0600 Local (1200 GMT)	12	29 Nov	0 5 10 20	0620				19.6 20.5 21.2 23.1	30.772 31.627 33.413 35.336	0.32 .27 .14 .04	14.5 10.6 7.0 2.1	7.5 5.6 2.7 0.6	1.102 0.826 1.558 0.500	0.217 .163 .103 .027	1.084 0.813 1.367 .667	1.500 1.200 2.100 1.000	1.044 .768 1.268 .442	0.239 .185 .211 .048	1.107 .836 1.483 .670	1.450 1.150 1.600 1.000
28°52'-5-N 89°49'-5-W 1526 Local (2126 GMT)	12-R	10 Dec	0 5 10 20	1535	5.0		12.6	17.0 18.0 18.7 20.3	29.581 29.727 31.313 34.656	0.29 .84 .49 .19	4.2 4.8 10.0 2.0	2.4 2.7 5.8 1.8	1.674 1.457 0.782 .609	0.059 0 0 0.087	1.321 1.026 0.724 .519	1.600 1.400 0.950 .900	1.500 1.341 0.667 .551	0.125 .049 .065 .109	1.390 0.798 0.496 0.542	1.500 1.400 0.950 0.850

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TABLE 12. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALYPSO AT STATIONS XIII - XVIII (LEG II) OFF MISSISSIPPI

Station Position	#	Date 1974	Depth (m)	Time Local	Secchi disc		Euphotic Zone Depth (m)	Temp. (°C)	Salinity (‰)	PO ₄ (μg.at/L)	SiO ₃ (μg.at/L)	NO ₃ (μg.at/L)	Total Chlorophyll			Plant Carotenoids (mg/m ³)	Nannoplankton			Plant Carotenoids (mg/m ³)
					dry (m)	wet (m)							a (mg/m ³)	b (mg/m ³)	c (mg/m ³)		a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
28°29'-5-S 89-48'-0-W 1225 Local (1825 GMT)	13	28 Nov	0 5 10 20 50 100	1320	34.0	43.5	85.0	23.2 23.8 23.8 23.8 18.0	35.808 35.772 35.759 35.771 35.767 36.258	0.02 .01 .01 0 0 0.39	1.3 1.0 1.3 1.3 1.2 6.1	0.3 0.1 .2 1 0.05 11.8	0.377 .486 .326 268 326 268	0.174 .234 .092 .136 .092 .136	0.612 484 .716 .464 .716 464	1.000 1.000 0.850 700 850 .650	0.377 377 .326 268 326 268	0.174 174 .114 136 .092 136	0.612 .612 .441 464 .716 464	0.800 650 730 .550 .700 550
28°34'-4-S 89-55'-0-W 1045 Local (1645 GMT)	14	28 Nov	0 5 10 20 50 100	1105	8.25	10.75	20.8	21.8 22.8 22.8 22.8 22.8 18.2	35.493 35.501 35.493 35.459 35.461 36.308	0.03 .02 .03 .02 .02 .39	2.2 2.2 2.2 2.2 2.2 5.3	0.4 .5 .5 .4 3 11.8	0.659 0.551 .326 .326 .551 326	0.124 .109 .114 .114 .109 .092	0.964 .542 .441 .441 .542 .716	1.300 1.050 0.700 0.750 1.000 0.750	0.659 .551 .326 .326 384 268	0.124 109 .114 .114 070 136	0.964 .542 .441 .441 .693 .464	1.000 1.030 0.650 700 730 700
28°43'-45-N 90-01'-08-W 0820 Local (1420 GMT)	15	28 Nov	0 5 10 20 40	0900	10.0	11.7	25.3	22.5 22.9 22.9 22.9 22.9	35.580 35.560 35.986 35.567 35.575	0.03 0.02 .02 .23 .04	2.1 2.1 2.1 1.8 2.1	0.6 .5 3 .2 4	0.551 .768 .768 .768 652	0.107 .162 .185 .162 .228	0.542 1.111 0.836 1.111 0.883	0.900 1.300 1.250 1.250 1.250	0.551 .659 660 .601 .544	0.109 124 147 146 .544	0.542 964 689 587 461	0.850 1.100 1.050 1.050 1.000
28°52'-30-N 90-01'-15-W 0600 Local (1200 GMT)	16	28 Nov	0 5 10 20	0648	2.0	3.5	5.0	18.6 20.5 22.0 23.3	28.364 32.206 35.547 35.132	0.50 .26 .19 .10	21.8 10.5 6.7 3.6	11.0 4.7 3.0 1.6	1.101 1.327 0.884 .602	0.195 0.212 0.119 .168	1.359 1.185 1.065 .712	1.450 1.600 1.300 1.250	0.826 .928 717 435	0.141 .282 103 152	1.088 1.154 941 588	1.250 1.000 1.250 1.150
28°32'-5-N 90-17'-0-W 2010 Local (0210 GMT)	17	8 Dec	0 5 10	2045				18.7 19.0 19.1	33.585 33.569 33.564	0.17 .13 .19	0.8 1.0 0.5	0.6 .5 .6	6.371 6.857 6.769	0.168 .380 .076	4.291 5.049 4.597	5.000 5.850 5.750	2.414 2.748 2.638	0 0 0	1.131 1.379 1.507	2.090 2.250 2.150
28°40'-30-N 90-12'-30-W 1733 Local (2333 GMT)	18	28 Nov	0 5 10 20	1745				21.2 22.5 22.5 22.5	35.348 35.389 35.310 35.304				0.775 0.776 .609 .884	0.081 .103 .087 .119	0.918 .643 .519 1.065	1.200 1.100 1.000 1.300	0.660 0.43 609 .768	0.147 0.43 .087 0.185	0.689 771 .519 .836	1.050 1.000 0.950 1.100

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TABLE 13. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ONBOARD THE R/V CALYPSO AT STATIONS XXIV - XXIV (LEG II) OFF MISSISSIPPI.

Station Position	#	Date 1974	Depth (m)	Time Local	Secchi disc		Bathymetric Zona Depth(m)	Temp. (°C)	Salinity (‰)	PO ₄ (μg-at/L)	SiO ₃ (μg-at/L)	NO ₃ (μg-at/L)	TOTAL CHLOROPHYLL			Plant Carotenoids (mg/m ³)	a			Plant Carotenoids (mg/m ³)
					dry (m)	wet (m)							a (mg/m ³)	b (mg/m ³)	c (mg/m ³)		a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
28°28-0-N 90-09-5-W 1538 Local (2138 GMT)	19	28 Nov	0 5 10 20 50	1610	7.25	9.00	18.6	21.5 23.9 23.0 23.0	35.649 35.582 35.579 35.599	0.05 .04 .05 .04	2.3 2.3 1.6 2.2	0.6 .3 2 .2	0.877 0.775 0.884 .550	0.223 .081 .119 .086	0.983 0.918 1.065 0.817	1.300 1.100 1.300 1.000	0.594 718 .768 .550	0.250 .125 .185 .086	0.906 .666 836 817	1.200 1.100 1.150 1.000
28°18-5-N 89-57-0-W 0710 Local (1310 GMT)	20	8 Dec	0 5 10 20 50	0800	7.5		19.2	19.6 20.2 20.3 22.3	34.555 34.541 34.577 35.915	0.11 0.18 .20 .05	3.7 2.7 2.4 1.0	1.0 1.1 0.6 0.3	2.095 1.101 1.203 0.710	0.396 .195 .337 .184	2.021 1.359 1.425 1.134	2.450 1.350 1.550 1.200	1.087 0.869 1.037 0.652	0.380 .282 320 .228	1.471 1.452 1.301 0.883	1.450 1.250 1.350 1.750
28°06-5-N 90-10-0-W 1000 Local (1600 GMT)	21	8 Dec	0 5 10 20 50	1030	19.0		48.0	22.3 22.7 22.7 22.7	35.932 35.890 35.969 35.961	0.04 .05 0 0.05	0 2.3 0.9 1.1	0.2 .3 .2 .5	0.593 0.377 .594 .485	0.205 .174 .228 .190	1.456 0.612 1.181 1.034	1.150 0.750 1.250 0.900	0.536 .377 .536 .428	0.249 .174 .271 .233	1.204 0.612 .929 .782	1.100 0.700 1.150 0.850
28°19-5-N 90-24-0-W 1308 Local (1908 GMT)	22	8 Dec	0 5 10 20 40	1330	6.0		15.2	17.5 18.3 18.4 18.7 21.3	33.061 33.054 33.128 33.874 35.776	0.27 .34 .35 .12 .07	5.5 5.1 2.7 2.2 0.9	1.2 0.9 .8 1.3 0.6	3.973 2.683 2.640 0.994 .637	0.717 .120 0 0.201 .369	3.748 1.320 0.957 .662 1.545	4.200 2.900 2.250 1.150 1.050	2.205 1.595 1.835 0.884 594	0.456 0.347 0.201 141 .228	1.693 1.649 1.088 0.790 1.181	2.500 1.800 2.000 1.150 1.000
28°36-0-N 90-32-0-W 1538 Local (2138 GMT)	23	8 Dec	0 5 10 20	1600	5.5		13.8	17.6 18.3 18.3 21.0	32.567 32.563 32.555 35.252	0.25 0.17 0.21 0.24	6.7 7.8 6.3 4.9	1.5 1.5 1.5 2.6	4.198 4.415 4.582 0.667	0.082 .158 .174 .065	2.323 2.618 2.742 0.496	3.550 3.700 3.800 0.850	1.878 1.538 1.487 0.551	0.320 .391 .332 1.109	1.727 1.397 1.227 0.542	2.100 1.800 1.750 0.800
28°52-3-N 90-33-5-W 1800 Local (0000 GMT)	24	8 Dec	0 5 10	1820				16.8 18.3 18.4	31.997 31.993 32.443	0.50 .27 .22	9.2 7.3 3.4	4.7 3.2 1.8	1.951 2.726 2.465	0.158 0.239 .022	1.042 1.959 1.301	1.700 2.400 2.200	1.384 1.857 1.769	0.168 .587 .282	1.437 2.032 1.580	1.550 2.150 1.950

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TABLE 14. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALYPSO AT STATION CONTOY (LEG III)

Station	Sample No.	Date 1974	Time Local	Secchi Disc	Euphotic Zone Depth (m)	Temp. (°C)	Salinity (‰)	PO ₄ (μg-at/L)	SiO ₂ (μg-at/L)	NO ₃ (μg-at/L)	Total Chlorophyll			Plant Carotenoids (mg/m ³)	Nannoplankton			Plant Carotenoids (mg/m ³)
											a (mg/m ³)	b (mg/m ³)	c (mg/m ³)		a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
Isias Contoy (Local + Sh-GHT)	1	27 Dec	0600	4.50	11.3	22.9	36.353	0.19	0.3	0.8	0.776	0.103	0.643	1.100	0.544	0.190	0.735	1.000
	2		0800	5.00	12.6	22.7	36.375	.13	.7	1.0	.891	.038	.871	1.400	.594	.228	1.181	1.050
	3		1000	4.75	11.9	22.6	36.307	.10	.7	1.0	.927	.260	1.429	1.700	.703	.266	1.328	1.350
	4		1200	4.25	10.6	22.8	36.322	.10	.4	0.7	1.152	.255	1.529	1.800	.754	.347	1.223	1.450
	5		1400	4.25	10.6	23.0	36.330	.35	.6	.6	1.551	.184	1.560	2.150	1.087	.358	1.746	1.750
	6		1600	4.00	10.0	23.1	36.324	.08	.4	.4	1.211	.255	1.231	1.750	0.761	.266	1.030	1.300
	7		1800			23.1	36.314	.07	.7	.5	.884	.141	.790	1.500	.652	.228	.883	1.200
Isias Contoy	8	28 Dec	0500	5.00	12.6	23.5	35.272	0.07	0.3	0.2	0.326	0.092	0.716	0.800	0.268	0.136	0.464	0.700
	9		0800	4.75	11.9	23.4	35.306	.01	.4	.03	.376	.152	.887	.950	.326	.092	.716	.800
	10		1000	4.50	11.3	23.4	36.383	.0	.7	.05	.486	.212	.759	1.050	.428	.233	.782	1.000
	11		1200	4.00	10.0	23.7	36.326	.07	.4	.2	.652	.228	.883	1.200	.543	.168	1.010	1.050
	12		1400	5.00	12.6	24.0	35.320	.10	.4	.5	.753	.325	1.498	1.600	.594	.250	0.906	1.500
	13		1600	5.00	12.6	23.8	36.317	.04	.6	.1	.601	.146	0.987	1.400	.602	.168	.712	1.350
	14		1800			23.9	36.312	.08	.7	.3	.543	.168	1.010	1.250	.544	.190	.735	1.300
Isias Contoy	15	29 Dec	0500	5.25	13.1	22.8	36.352	0.09	0.4	0.2	0.819	0.244	1.006	1.200	0.594	0.250	0.906	1.150
	16		0800	5.25	13.1	22.9	36.342	.03	.4	.3	.877	.200	1.258	1.300	.594	.228	1.181	1.200
	17		1000	5.50	13.8	23.0	36.334	.03	.6	.2	.986	.261	1.130	1.500	.645	.309	1.076	1.450
	18		1200	5.25	13.1	23.1	36.346	.01	.3	.1	1.326	.190	1.460	1.750	.645	.287	1.351	1.500
	19		1400	5.25	13.1	23.1	36.364	.08	.2	.1	1.486	.309	1.502	2.050	.638	.391	1.270	1.600
	20		1600	5.25	13.1	23.0	36.358	.02	.3	.05	1.261	.315	1.401	1.700	.863	.385	1.370	1.800
	21		1800			23.0	36.375	.01	.3	.1	1.037	.320	1.301	1.550	.978	.320	1.599	1.600
Isias Contoy	22	30 Dec	0500	5.50	13.8	23.7	36.374	0	0	0	0.659	0.124	0.964	0.900	0.544	0.190	.735	.850
	23		0800	5.50	13.1	22.7	36.374	0	0	0	.710	.205	.859	1.000	.601	.146	.987	.900
	24		1000	5.00	12.6	23.0	36.374	0.07	0	0	.819	.222	1.281	1.150	.710	.184	1.134	1.150
	25		1200	5.00	12.6	23.0	36.386	.03	0.1	0	.985	.238	1.405	1.400	.935	.179	1.235	1.250
	26		1400	5.25	13.1	23.1	36.371	.05	.1	0	1.210	.233	1.506	1.700	.928	.282	1.154	1.350
	27		1600	5.25	13.1	23.2	36.345	.13	0	0.05	1.037	.320	1.301	1.350	.877	.223	0.983	1.300
	28		1800			23.2	36.359	.01	0.1	0	0.819	.244	1.006	1.200	.877	.223	.983	1.250
Isias Contoy	29	1 Jan 1975	1000	5.00	12.6	23.0	36.329	0.20	0.1	0.3	0.652	0.228	0.883	1.050	0.543	0.168	1.010	1.000
	30		1200	5.25	13.1	23.2	36.338	0	.4	0	.869	.282	1.452	1.450	.826	.141	1.088	1.250
	31		1400	5.00	12.6	23.2	36.335	0	.5	0	1.138	.418	1.916	1.900	.870	.304	1.177	1.600
	32		1600	5.00	12.6	23.5	36.339	0	.7	0	0.920	.342	1.622	1.700	.819	.244	1.006	1.500

TABLE-15. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V GALAPGO AT STATION CONTOY (LEG III)

Station	Sample No.	Date 1975	Time Local	Secchi Disc (m)	Euphotic Zone Depth (m)	Temp. (°C)	Salinity (o/oo)	PO ₄ (μg.at/L)	SiO ₃ (μg.at/L)	NO ₃ (μg.at/L)	Total Chlorophyll			Plant Carotenoids (mg/m ³)	Nannoplankton			Plant Carotenoids (mg/m ³)
											a (mg/m ³)	b (mg/m ³)	c (mg/m ³)		a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
Isles Contoy (Local + 5h GMT)	33	6 Jan	1000	5.25	13.1	23.7	36.335	0	0.3	0	0.703	0.266	1.328	1.000	0.652	0.228	0.883	1.150
	34		1200	5.00	12.6	23.9	36.346	0	.3	0	1.587	.407	2.118	2.300	.869	.282	1.452	1.503
	35		1400	5.00	12.6	23.9	36.342	0.01	.5	0	1.304	.434	2.040	2.100	.920	.342	1.622	1.650
	36		1600	5.00	12.6	24.0	36.340	0.01	.5	0.05	1.029	.380	1.769	1.950	.971	.423	1.517	1.750
Isles Contoy	37	7 Jan	1000	5.00	12.6	23.8	36.334	0.08	0.3	0	0.710	0.184	1.134	1.050	0.544	0.190	0.735	0.900
	38		1200	5.00	12.6	23.9	36.331	.01	.3	0	1.036	.298	1.576	1.950	.594	.250	.906	1.500
	39		1400	5.00	12.6	24.0	36.333	0	.4	0	.927	.260	1.429	1.650	.703	.266	1.328	1.600
Isles Contoy	40	8 Jan	1000	5.25	13.1	23.7	36.334	0.03	0.3	0	0.819	0.244	1.006	1.550	0.486	0.212	0.759	0.950
	41		1200	5.00	12.6	23.9	36.338	.06	.3	0	.927	.260	1.429	1.750	.594	.228	1.181	1.200
	42		1400	5.00	12.6	24.0	36.341	0	.3	0	.977	.200	1.258	1.650	.536	.271	.929	1.050
Isles Contoy	43	9 Jan	1200	5.00	12.6	23.5	36.344	0.07	0.3	0	0.761	0.266	1.030	1.450	0.594	0.250	0.906	1.200
	44		1400	4.75	11.9	23.4	36.337	.0	.4	0.05	.985	.238	1.405	1.750	.703	.266	1.328	1.500
	45		1600	4.50	11.3	23.6	36.338	0.13	.3	0	.601	.146	.987	.850	.544	.190	0.735	1.000
Isles Contoy	46	10 Jan	1200	4.75	11.9	22.8	36.338	0	0.5	0.05	0.761	0.266	1.030	1.400	0.652	0.228	0.883	1.250
	47		1400	4.00	10.0	22.9	36.338	0.22	.1	0	.819	.222	1.281	1.450	.652	.206	1.158	1.350
	48		1600	3.75	9.5	22.9	36.335	.02	.4	0	.601	.146	0.987	0.950	.601	.146	.987	1.050
Isles Contoy	49	15 Jan	1000	2.75	7.00	23.1	36.334	0.01	0.4	0	0.819	0.244	1.006	1.400	0.768	0.162	1.111	1.350
	50		1200	2.75	7.00	23.1	36.325	.09	.1	0.05	1.493	.228	1.309	2.250	.928	.282	1.154	1.750
	51		1400	2.75	7.00	23.1	36.333	0	.4	0	1.275	.130	1.289	1.950	.993	.157	1.212	1.850
Isles Contoy	52	16 Jan	1200	3.50	8.8	22.4	36.326	0.04	0.3	0	1.537	0.369	1.672	2.250	1.051	0.135	1.189	1.550
	53		1400	3.50	8.8	22.4	36.322	0	.4	0	1.327	.212	1.185	1.850	1.102	.217	1.084	1.800
	54		1600	4.00	10.0	22.6	36.334	0	.4	0	0.877	.223	0.983	1.350	0.826	.141	1.088	1.350
Isles Contoy	55	17 Jan	1000	4.00	10.0	22.1	36.333	0.08	0.3	0	0.652	0.206	1.158	1.200	0.601	0.146	0.987	1.000
	56		1200			22.2	36.334	.04	.3	0	.877	0.200	1.258	1.550	.710	.184	1.134	1.250
	57		1400			22.7	36.334	.02	.5	0.05	.819	.244	1.006	1.400	.761	.266	1.030	1.350
	58		1600			22.3	36.326	.14	0	0	.710	.184	1.134	1.300	.710	.206	.859	1.200
Isles Contoy	59	18 Jan	1000			23.0	36.329	0.01	0.4	0	0.761	0.266	1.030	1.300	0.544	0.190	0.735	1.050
	60		1200			23.1	36.329	.02	0.4	0	1.203	.314	1.700	1.750	.812	.326	1.200	1.400

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TABLE 16. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALYPSO AT STATIONS X- XIII(LEG III)

Station	No.	Date 1975	Depth (m)	Time Local	Secchi Disc (m)	Euphotic Zone Depth(m)	Temp. (°C)	Salinity (o/oo)	PO ₄ (μg.at/L)	SiO ₃ (μg.at/L)	NO ₃ (μg.at/L)	Total Chlorophyll			Plant Carotenoids (mg/m ³)	Nannoplankton			Plant Carotenoids (mg/m ³)
												a (mg/m ³)	b (mg/m ³)	c (mg/m ³)		a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
21°25-15-N 86°22-3-W 1327 Local (1827 GMT)	X	21 Feb	0 5 10 25 50 75 100	1400	23.0	58.0	25.7 26.2 26.0 24.9 23.0 22.4 21.3	35.903 35.890 35.934 36.191 36.670 36.695 36.695	0.10 .08 .18 .15 .14 .32 .25	0.3 1.3 0.6 0.8 0.9 0.9 0.8	0.2 .1 .5 .7 .3 2.8 3.1	0.746 .544 .913 1.145 .820 652 .377	0.407 .190 .423 .358 .342 228 .174	1.692 .735 1.816 1.448 1.622 .883 612	1.200 850 1.500 1.300 1.500 1.050 850	0.573 .478 .573 645 587 .544 .319	0.494 .293 .494 287 .331 190 195	1.486 .952 1.486 1.351 1.099 0.735 .635	1.150 1.050 1.200 1.100 1.200 0.950 .900
21°41-4-N 85°57-3-W 1630 Local (2130 GMT)	XI	21 Feb	0 5 10 25 50 75 100	1705	> 35.0	> 88.0	25.9 26.3 26.2 26.1 26.0 25.8 25.5	35.830 35.814 35.823 35.938 36.016 36.148 36.350	0.15 .14 .10 .07 .10 .07 15	1.8 1.7 1.8 1.3 1.3 1.2 1.0	0.1 0 0 0 0 0.5 1.1	0.536 .326 .275 .275 .696 .775 .500	0.249 .114 .032 .032 1.246 .103 .027	1.204 0.441 .546 .546 1.246 0.643 .647	1.200 0.700 .600 650 1.500 1.200 0.900	1.485 .326 .275 275 .536 .544 .493	0.190 .114 .054 .032 249 190 130	1.034 441 .271 .546 1.204 733 565	1.050 0.700 0.600 0.600 1.200 1.150 0.900
22°19-0-N 84°57-2-W 0112 Local (0612 GMT)	XII	22 Feb	0 5 10 25 50 75 100	0210			25.7 26.3 26.3 26.3 26.2 25.9 25.8	35.858 35.846 35.854 35.861 35.958 36.036 36.039	0.07 .04 .04 .01 .06 .04 .02	1.2 1.2 1.3 1.4 1.2 1.5 1.4	0.1 0 0 0 0 0.1 0.3	0.376 .486 .326 .376 .645 .637 .326	0.152 .212 .092 .152 287 .369 .114	0.887 .759 .716 887 1.351 1.545 0.441	0.800 900 .700 .850 1.250 1.350 0.750	0.384 435 .326 326 .536 .529 .326	0.070 .152 .114 .092 271 353 114	0.693 588 .441 716 929 1.122 .441	0.750 850 650 750 1.050 1.150 0.700
22°36-6-N 83°59-0-W 0900 Local (1400 GMT)	XIII	22 Feb	0 5 10 25 50 75 100	0940	31.0	78.0	25.7 26.1 26.0 25.9 25.7 25.6 25.3	35.953 35.951 35.983 35.975 35.997 36.012 36.077	0.02 .03 .02 .01 .02 .01 .02	1.1 1.2 1.5 1.0 1.0 1.0 .7	0 0 0 0 0 0 0.1	0.377 .319 .268 .478 .319 370 .435	0.174 .195 .114 .293 .195 .255 .152	0.612 .635 .739 .952 .635 .805 .588	0.800 .700 .700 1.000 0.750 900 .950	0.326 .268 .268 .428 .326 319 377	0.092 136 136 .233 .092 .195 .174	0.716 .464 .464 .782 .716 .635 .612	0.700 .650 650 950 700 .750 .850

FOLOUT FRAME 2

FOLOUT FRAME

TABLE 17. PHYSICAL, CHEMICAL AND BIOLOGICAL DATA OBTAINED ON BOARD THE R/V CALYPSO AT STATIONS XIV - XVIII (LEG III)

Stn.	Date 1975	Depth (m)	Time Local	Secchi Disc (m)	Euphotic Zone Depth (m)	Temp. (°C)	Salinity (o/oo)	PO ₄ (μg-at/L)	SiO ₃ (μg-at/L)	NO ₃ (μg-at/L)	Total Chlorophyll			Plant Carotenoids (μg/m ³)	Nannoplankton			Plant Carotenoids (μg/m ³)
											a (mg/m ³)	b (mg/m ³)	c (mg/m ³)		a (mg/m ³)	b (mg/m ³)	c (mg/m ³)	
145-N 14-S-W Local (1950 GMT)	XIV 23 Feb	0	0130			25.0	35.977	0.01	0.9	0.1	0.326	0.092	0.716	0.850	0.268	0.136	0.464	750
		5				25.7	35.998	.08	.3	.4	.377	.174	.612	.900	.326	.092	.716	800
		10				25.6	35.926	.06	1	.2	.268	.136	.464	.600	.268	.136	.464	650
		25				24.9	36.041	.01	.9	.1	.268	.114	.739	.700	.268	.136	.464	650
		50				22.8	36.186	.02	.4	0	.486	.212	.759	1.000	.436	.130	.863	950
		75				22.0	36.150	.02	.3	0.3	.550	.086	.817	1.000	.377	.174	.612	650
		100				21.5	36.239	.01	1.2	2.0	.319	.195	.635	0.650	.326	.092	.716	.750
14-S-W 10-7-W Local (1950 GMT)	XV 23 Feb	0	0655			25.4	36.010	0.16	1.0	0.7	0.268	0.138	0.464	0.700	0.268	0.136	0.464	0.650
		5				25.8	36.021	.08	1.2	0.1	.217	.054	.569	.700	.217	.054	.569	0.600
		10				25.8	36.001	.15	1.3	0.5	.159	.098	.317	.400	.159	.098	.317	.400
		25				25.8	36.015	.08	0.1	0.4	.217	.054	.569	.650	.159	.098	.317	.450
		50				25.8	36.006		0.6	.4	.326	.092	.716	.750	.217	.054	.569	.650
		75				25.7	36.011	.03	1.1	.1	.268	.114	.739	.650	.217	.054	.569	.550
		100				25.1	36.175	.03	0.9	.3	.376	.152	.887	.950	.268	.114	.739	.750
14-S-W 10-7-W Local (1950 GMT)	XVI 23 Feb	0	1035	32.0	80.0	25.4	36.047			4.3	0.326	0.092	0.716	0.750	0.268	0.136	0.464	0.750
		5				25.8	35.985	0.06	0.1	0.2	.326	.092	.716	.750	.326	.092	.716	.750
		10				25.8	35.980	.07	.7	.1	.377	.174	.612	.850	.326	.092	.716	.800
		25				25.8	35.988	.07	1.0	0	.376	.152	.887	.950	.377	.174	.612	.900
		50				25.8	35.974	.16	0.9	0.4	.486	.212	.759	1.000	.434	.130	.863	.950
		75				25.5	36.067	.13	.7	0.2	.660	.347	.689	1.100	.544	.190	.735	1.050
		100				25.3	36.141	.06	7	0.4	.753	.325	1.498	1.500	.594	.250	.906	1.250
14-S-W 10-7-W Local (1950 GMT)	XVII 23 Feb	0	1255	30.0	76.0	25.6	35.990	0.03	0	0.1	0.485	0.190	1.034	1.050	0.377	0.174	0.612	0.900
		5				25.8	35.988	.06	1.0	0.1	0.370	0.255	0.805	0.950	.326	.092	.716	.850
		10				25.8	35.969	.03	1.2	0	.370	.255	.805	1.000	.319	.195	.635	.850
		25				25.8	35.959	.13	0.4	0.2	.319	.195	.635	0.850	.319	.195	.635	.800
		50				25.8	36.015	.02	1.2	0	.485	.190	1.034	1.050	.376	.152	.887	.950
		75				25.6	36.071	.02	.6	0	.268	.114	0.739	0.750	.268	.136	.464	.700
		100				25.2	36.211	.03	1.0	0.5	.645	.287	1.351	1.400	.594	.250	.906	1.300
14-S-W 10-7-W Local (1950 GMT)	XVIII 23 Feb	0	1510	27.0	68.0	25.0	35.045	0.02	1.2	0.1	0.427	0.211	1.057	1.050	0.370	0.255	0.805	0.950
		5				25.2	35.997	.06	0.5	0.2	.370	.255	0.805	0.950	.318	.173	.610	.900
		10				25.1	35.023	.02	1.1	0	.478	.293	.952	1.050	.369	.233	1.080	1.000
		25				24.8	36.059	.02	1.1	0	.318	.173	.610	0.900	.319	.195	.635	.900
		50				22.8	36.155	.02	0.6	0	.427	.211	1.057	1.000	.427	.211	1.057	.950
		75				21.8	36.167	.06	1.3	0.5	1.037	.320	1.301	1.750	.710	.184	1.134	1.450
		100				21.2	36.202	.16	1.5	2.7	0.318	.173	0.910	0.900	.319	.195	.635	.900

TABLE 18. MINIMUM, MAXIMUM, AVERAGE AND NUMBER OF OBSERVATIONS OF TEMPERATURE, SALINITY, DEPTH OF EUPHOTIC ZONE, CHLOROPHYLL A, PHOSPHATES, SILICATES AND NITRATES VALUES OBTAINED DURING LEG I OF R/V CALYPSO CRUISE (NOVEMBER 9 - 20, 1974)

	Minimum	Maximum	Average	No. Observations
Temperature (°C)	19.1	23.6	21.308	204
Salinity (°/oo)	8.821	36.342	33.504	206
Euphotic Zone (m)	1.26	76.0	22.811	154
Chlorophyll <u>a</u> (mg/m ³)	0.217	2.017	0.591	206
Phosphates (µg.at/L)	0.15	5.06	0.784	206
Silicates (µg.at/L)	0.4	32.6	5.46	206
Nitrates (µg.at/L)	0.0	> 40.0	1.77	206

TABLE 19. MINIMUM, MAXIMUM, AVERAGE AND NUMBER OF OBSERVATIONS OF TEMPERATURE, SALINITY, DEPTH OF EUPHOTIC ZONE, CHLOROPHYLL A, PHOSPHATES, SILICATES AND NITRATES VALUES OBTAINED DURING LEG II OF R/V CALYPSO CRUISE (NOVEMBER 26 - DECEMBER 12, 1974).

	Minimum	Maximum	Average	No. Observations
Temperature (°C)	16.8	23.8	22.22	143
Salinity (‰)	27.441	36.308	34.186	143
Euphotic Zone (m)	1.26	85.0	28.05	24
Chlorophyll <u>a</u> (mg/m ³)	0.268	6.857	1.062	143
Phosphate (μg.at/L)	0	2.77	0.246	138
Silicate (μg.at/L)	0	42.8	4.502	138
Nitrate (μg.at/L)	0	25.2	2.473	138

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TABLE 20. MINIMUM, MAXIMUM, AVERAGE AND NUMBER OF OBSERVATIONS OF TEMPERATURE, SALINITY, DEPTH OF EUPHOTIC ZONE, CHLOROPHYLL A, PHOSPHATES, SILICATES AND NITRATES VALUES OBTAINED DURING LEG III OF R/V CALYPSO CRUISE (FEBRUARY 20 - 25, 1975).

	Minimum	Maximum	Average	No. Observations
Temperature (°C)	21.2	26.3	25.173	63
Salinity (°/oo)	35.052	36.695	36.569	63
Euphotic Zone (m)	58.0	> 88.0	74.666	6
Chlorophyll <u>a</u> (mg/m ³)	0.159	1.145	0.4518	63
Phosphate (μg.at/L)	0.01	0.32	0.0713	61
Silicate (μg.at/L)	0	1.8	0.963	61
Nitrate (μg.at/L)	0	4.3	0.406	63

Leg I

Area investigated: Eastern and N.E. Gulf of Mexico

Dates: November 8 - November 20, 1974

No. of stations occupied: 8

During Leg I, the Zodiacs operations, as mentioned above, were limited to Stations I, II, III, IV, V, VI, and VIII. NASA U-2 overflights were limited to the following stations: Stations II, III and IV.

Station I

This "Mudhole" station was occupied on November 9, 1974. The "Mudhole" is a warm, saline spring which produces obvious surface temperature discontinuities of approximately 7°C above the ambient coastal temperatures. The distribution of surface salinity, temperature, chlorophyll, and nutrients at this stations are plotted in Figures 2 -a through 2 -g.

Salinity and Temperature (Figures 2-a and 2-b)

Surface salinities obtained by CALYPSO and Zodiacs were noticeably higher at Array A than those recorded at B Array. The temperature data collected at this station seem to indicate that the CALYPSO was in the immediate vicinity of the warm subsurface spring. A progressive increase in temperature of nearly 4°C was observed between the innermost and outermost positions of the Zodiacs R at both the A and B Arrays. (See Fig. 1-b).

Euphotic Zone (Fig. 2-c)

In Array A, the depths of the euphotic zones showed gradual increase between the Zodiacs(R) observations (average 11.95 m); the CALYPSO Station (12.6 m) and the observations made by Zodiac(L) [average 13.0 m]. By comparison, the average depths of the euphotic zones at the 'B' Array were consistently shallower than at Array A.

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● = CALYPSO stations

▲ = Zodiac stations

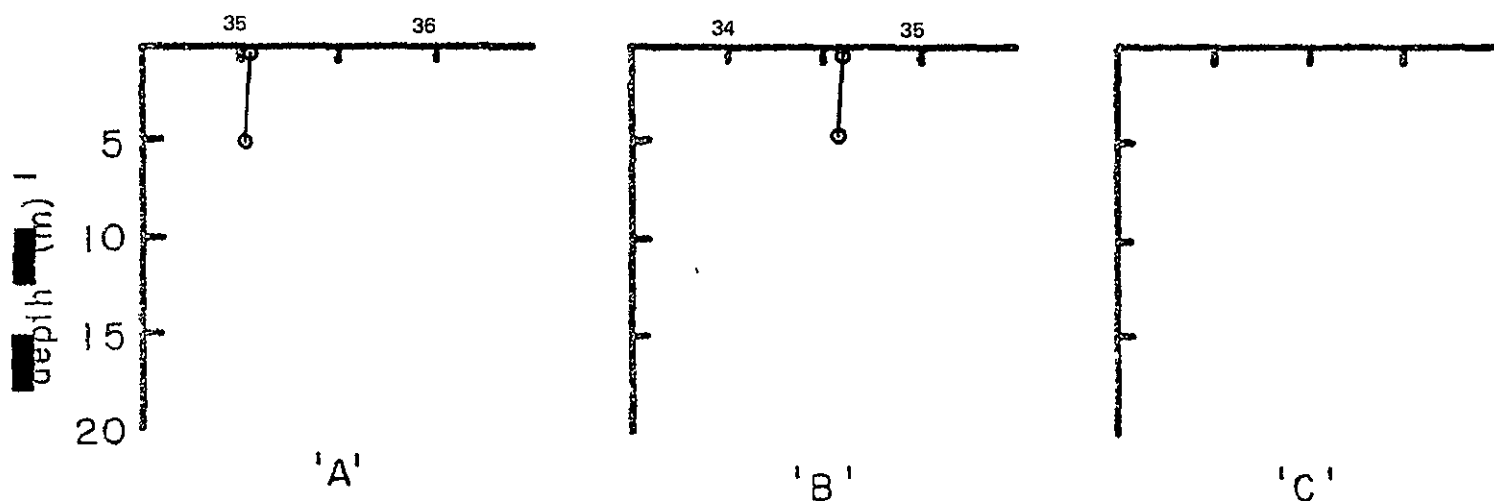
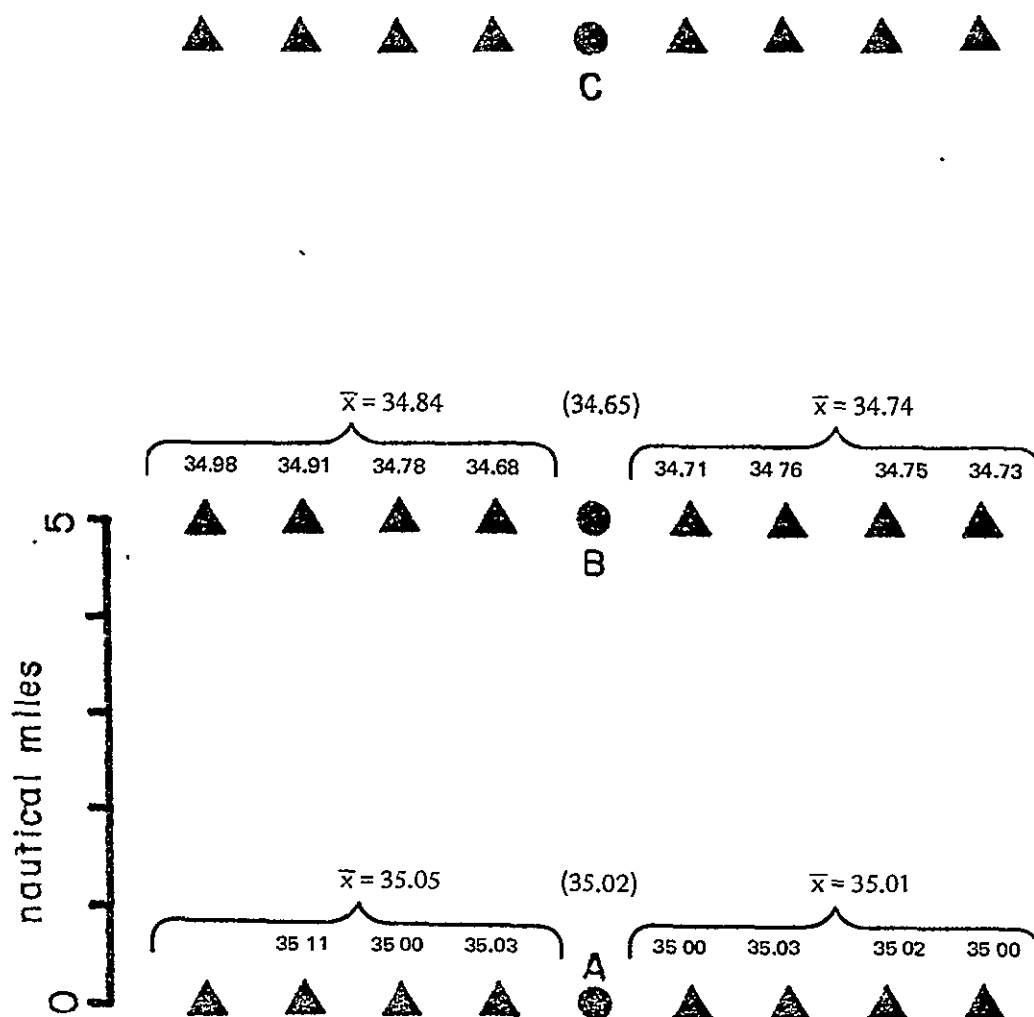


FIG. 2-a SURFACE AND VERTICAL DISTRIBUTION OF SALINITY ($^{\circ}/_{\infty}$) AT STATION I.

● = CALYPSO stations

▲ = Zodiac stations

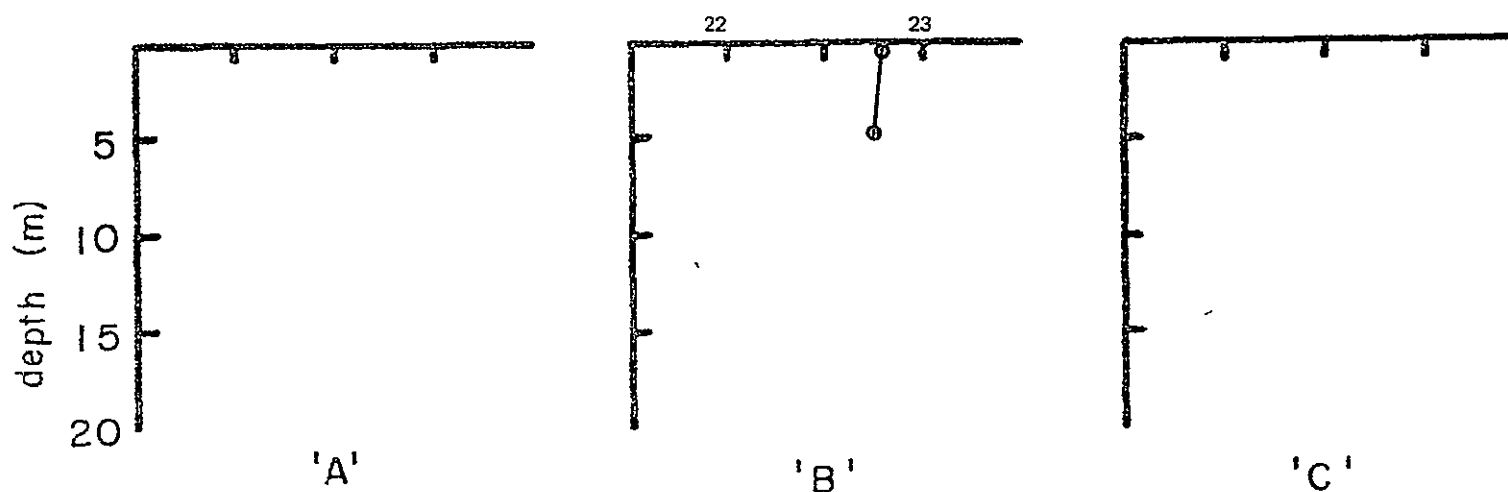
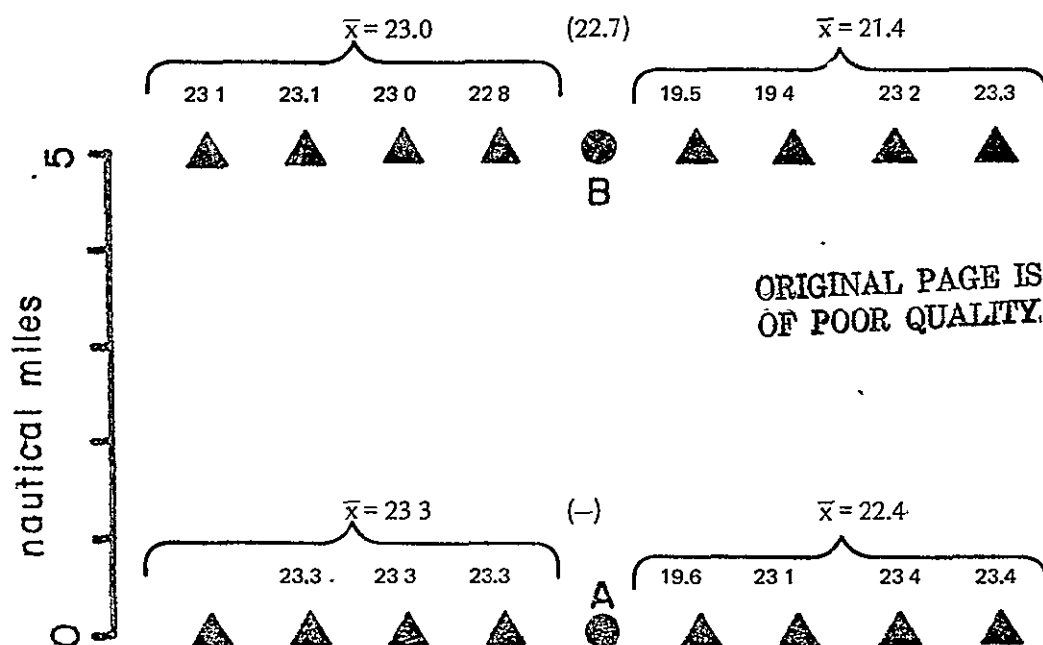
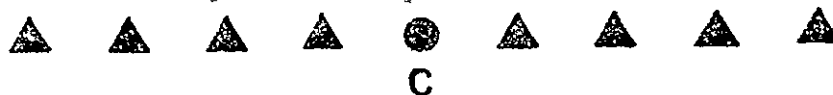


FIG. 2-b SURFACE AND VERTICAL DISTRIBUTION OF TEMPERATURE ($^{\circ}\text{C}$) AT STATION I.

● = CALYPSO stations
 ▲ = Zodiac stations

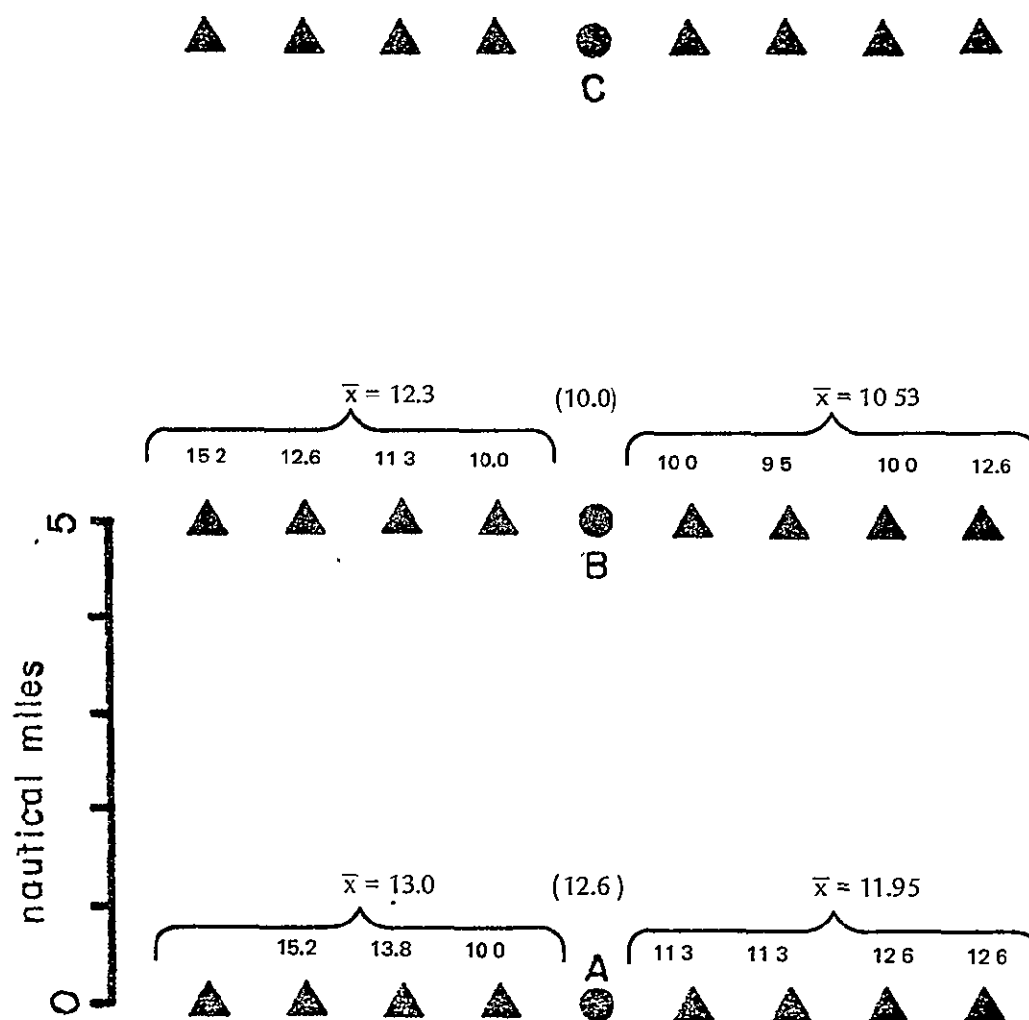


FIG. 2-c VERTICAL DISTRIBUTION OF THE EUPHOTIC ZONE (m) AT STATION 1.

Chlorophyll a (Fig. 2-d)

The standing crop of phytoplankton, in terms of chlorophyll a, is clearly higher at Array B compared to Array A for almost all the positions occupied. The higher chlorophyll a concentrations at Array B over those of A, perhaps may be explain the shallower euphotic zones at the former array compared to that of the latter. At both the A & B CALYPSO stations, surface chlorophyll a values were higher than at 5 m.

Nutrient Salts (Figs. 2-e, f and g)

In general, surface phosphate values were higher at Array B than those of Array A. The values collected by the CALYPSO and the two Zodiacs do not vary appreciably. Surface silicates and nitrates were also higher at Array B than Array A. Nutrient concentrations at the two positions occupied by the CALYPSO, showed higher values at the surface compared to depth of 5 m.

Station II

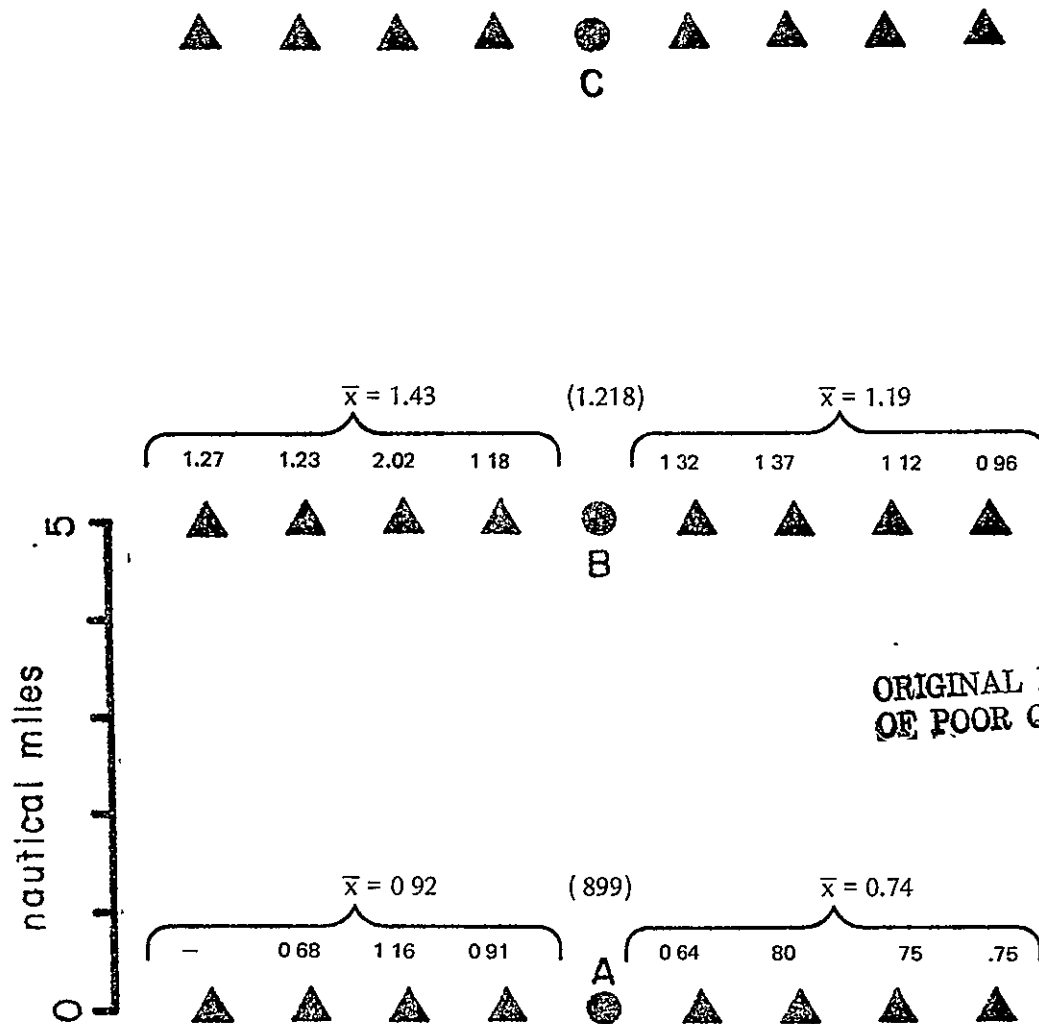
This station, which was occupied off Tampa Bay, Florida, on November 10, 1974, was selected as the first U-2 overflight operation station. Our main interest in this station was twofold: (a) to provide surface truth information for subtropical coastal waters which receive nutrient-rich water from a major coastal embayment; (b) to provide surface truth data in a coastal region which is generally noted for the outbreak of bloom of dinoflagellates responsible for the 'red tide' phenomenon.

Salinity (Fig. 3-a)

The distribution of salinity showed very slight variations between A, B and C Arrays. Further, the distribution of salinity at the CALYPSO positions showed very little salinity change with depth.

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● = CALYPSO stations
 ▲ = Zodiac stations



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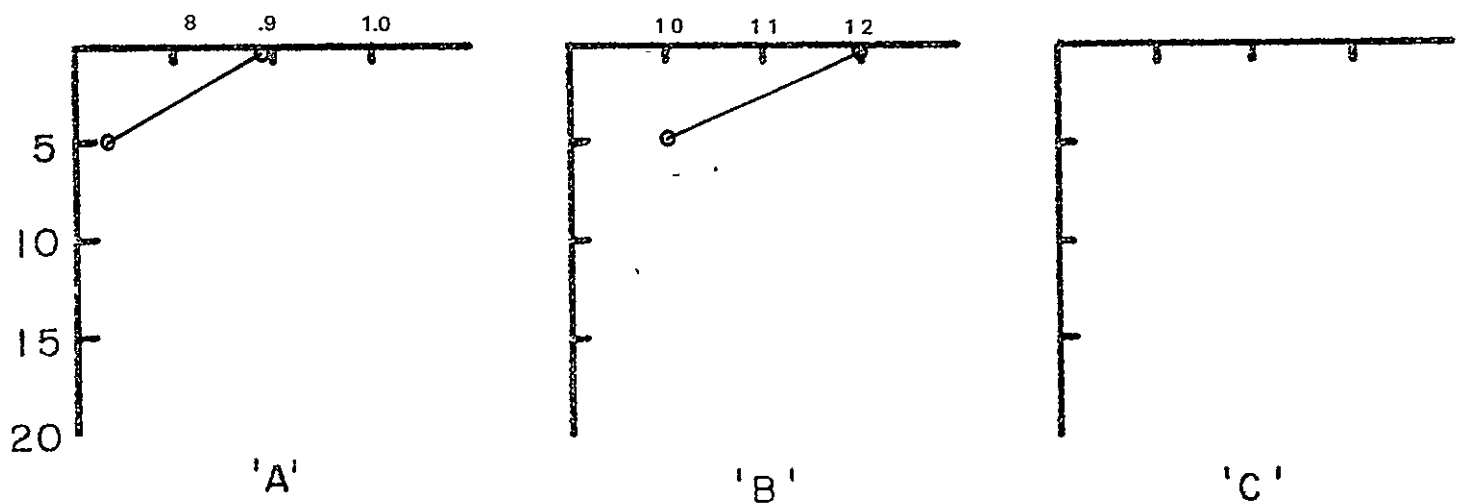
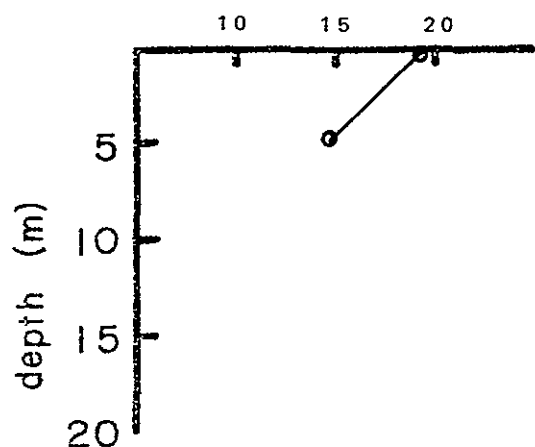
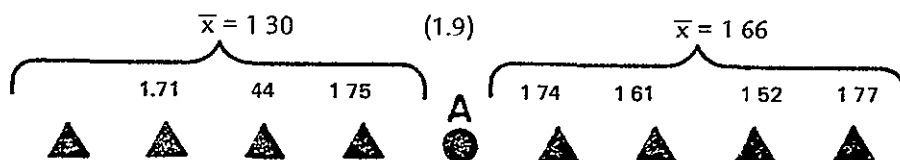
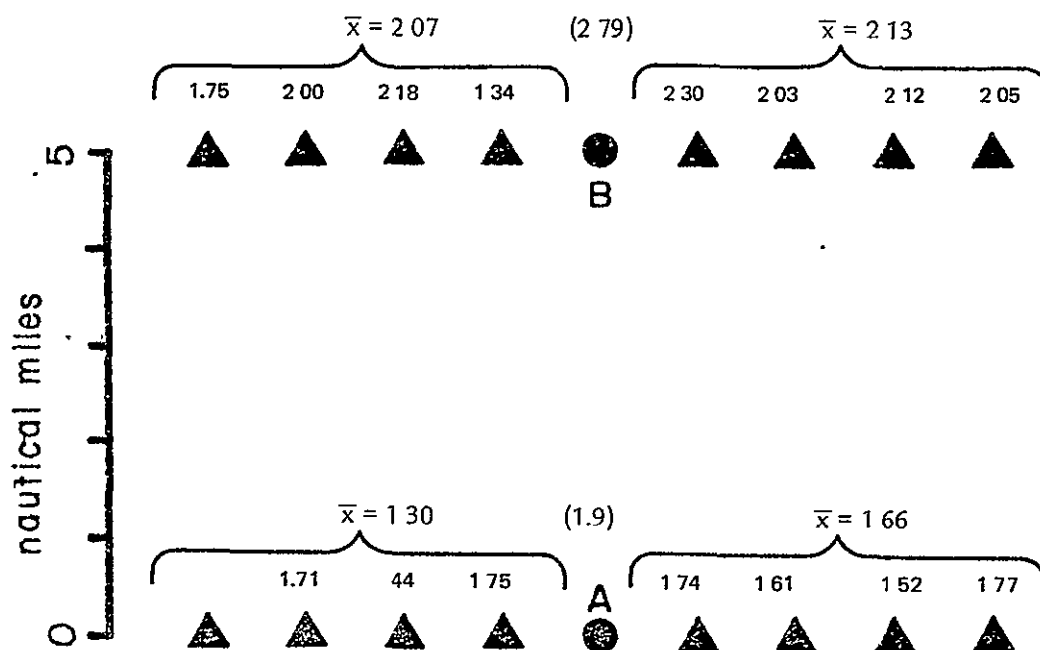


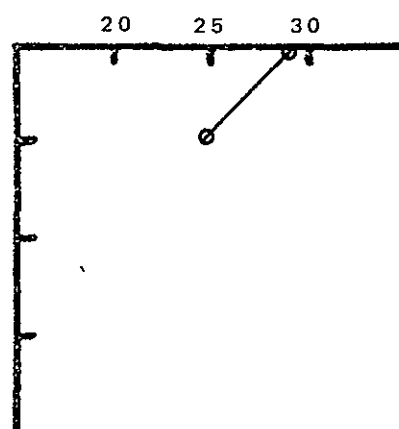
FIG. 2-d SURFACE AND VERTICAL DISTRIBUTION OF CHLOROPHYLL A (mg/m³) AT STATION I.

● = CALYPSO stations

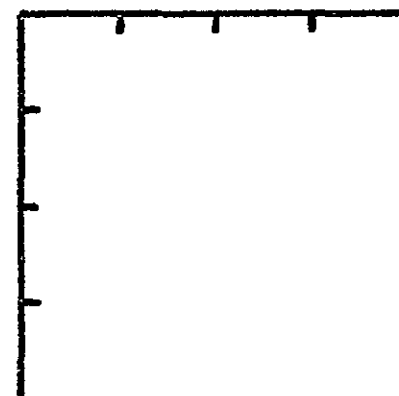
▲ = Zodiac stations



'A'



'B'

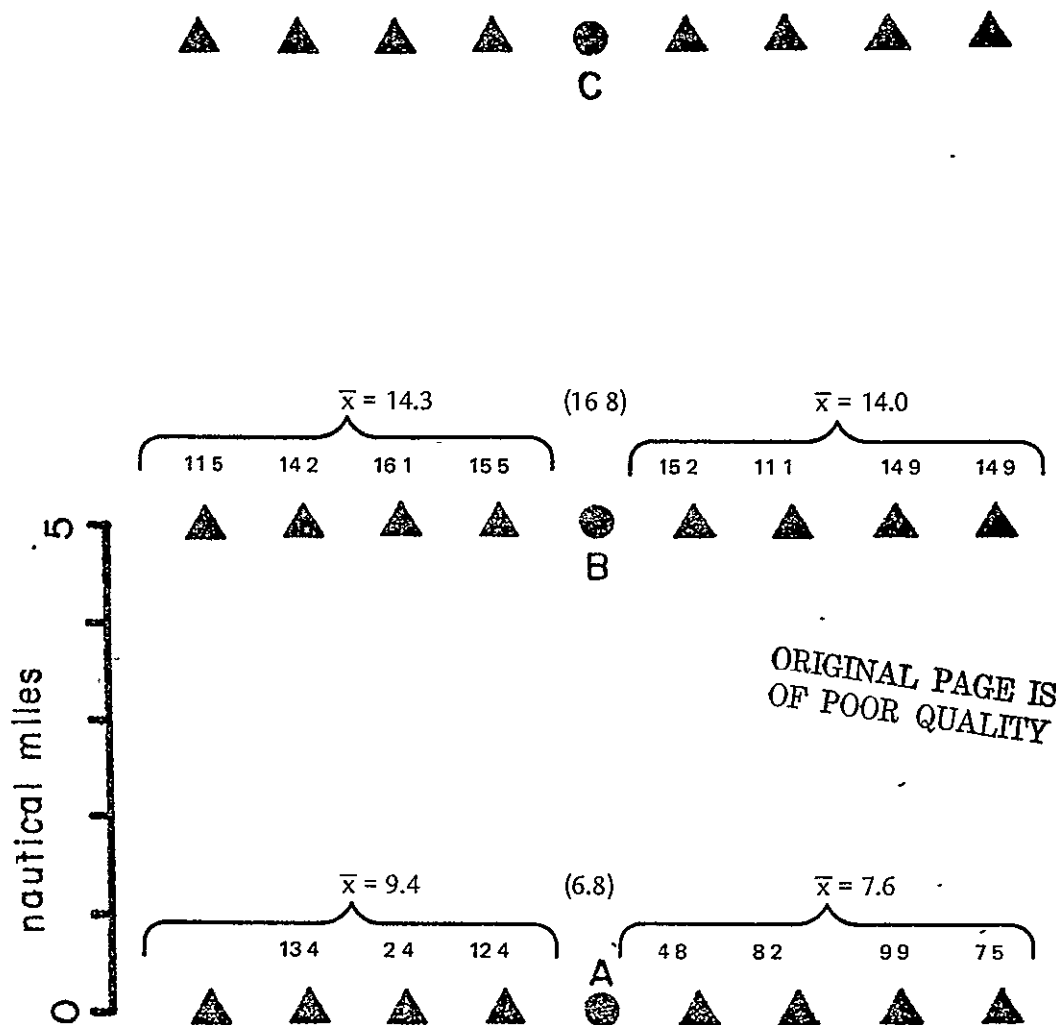


'C'

FIG. 2-e SURFACE AND VERTICAL DISTRIBUTION OF PHOSPHATE ($\mu\text{g-at/L}$) AT STATION I.

● = CALYPSO stations

▲ = Zodiac stations



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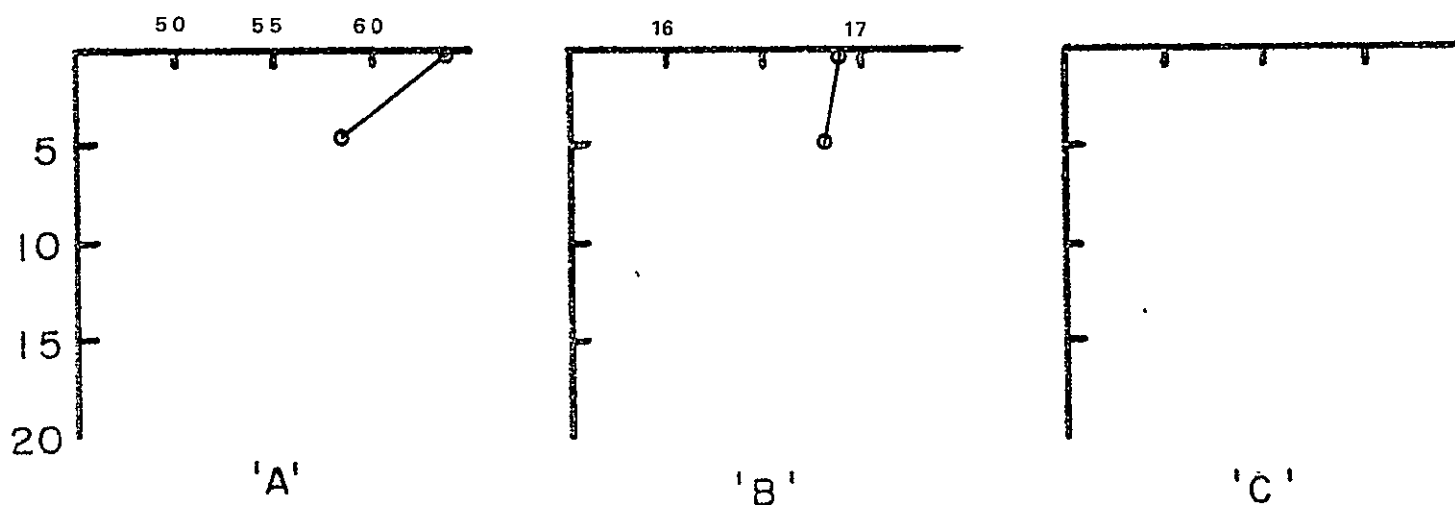


FIG. 2-f SURFACE AND VERTICAL DISTRIBUTION OF SILICATE ($\mu\text{g.at/L}$) AT STATION I

● = CALYPSO stations
 ▲ = Zodiac stations

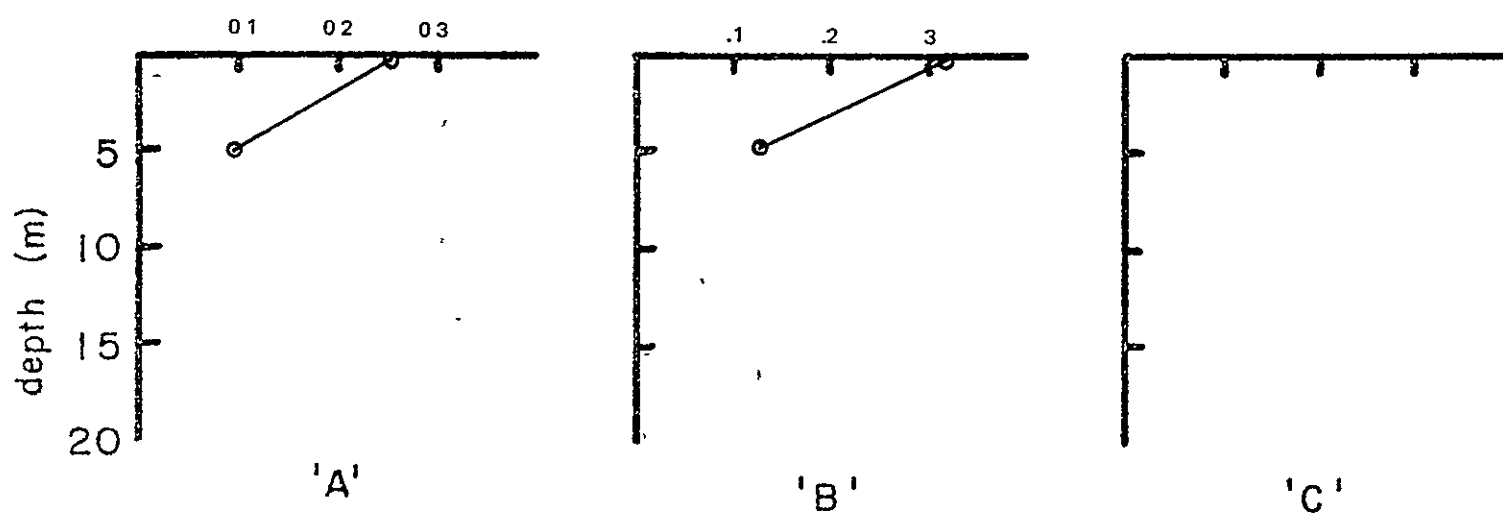
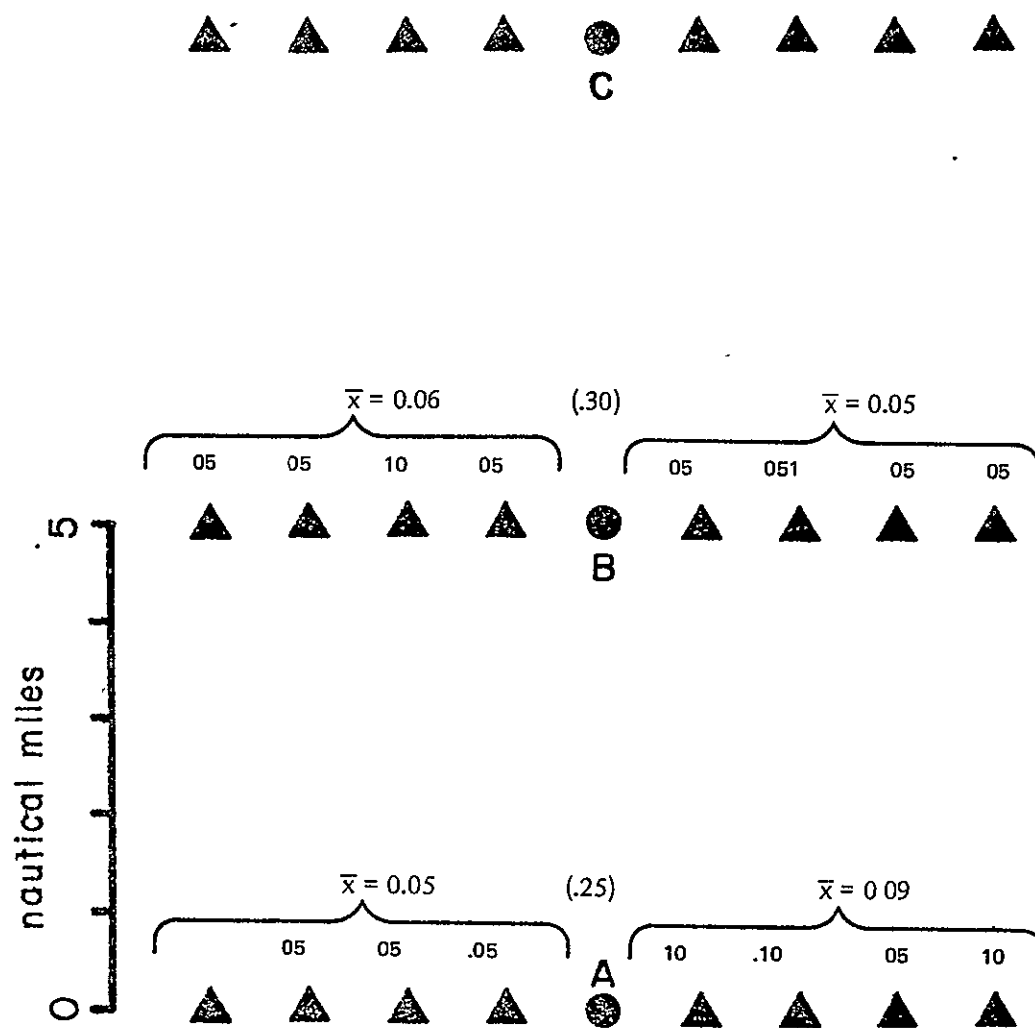


FIG. 2-g SURFACE AND VERTICAL DISTRIBUTION OF NITRATE ($\mu\text{g.at/L}$) AT STATION I.

● = CALYPSO stations

▲ = Zodiac stations

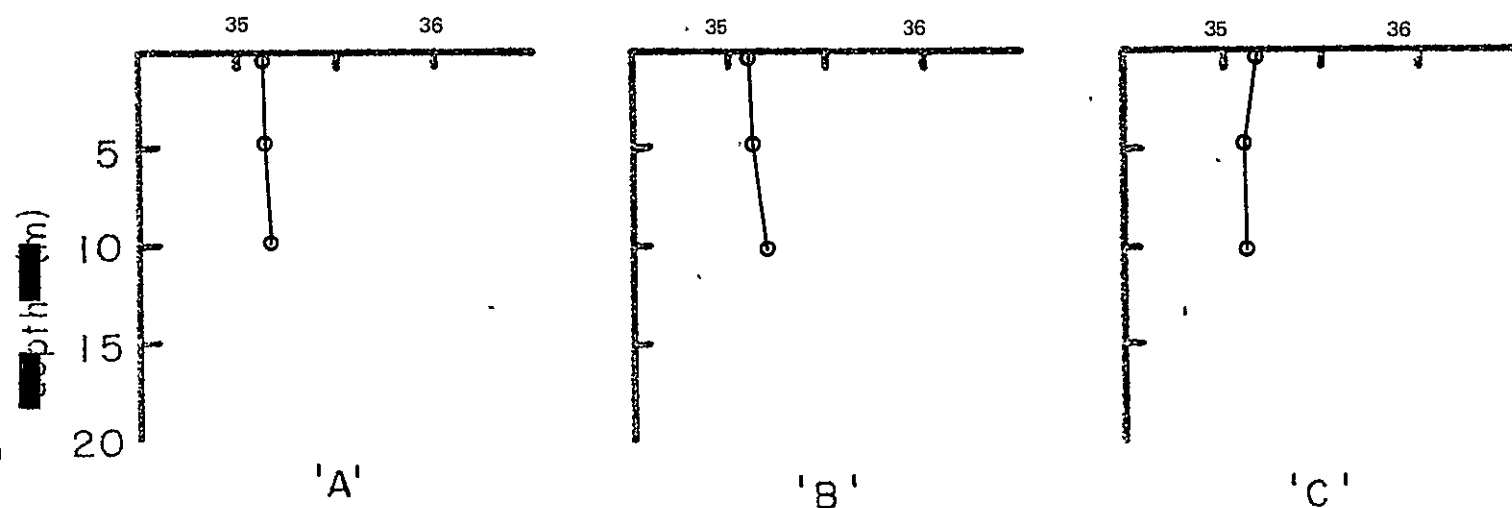
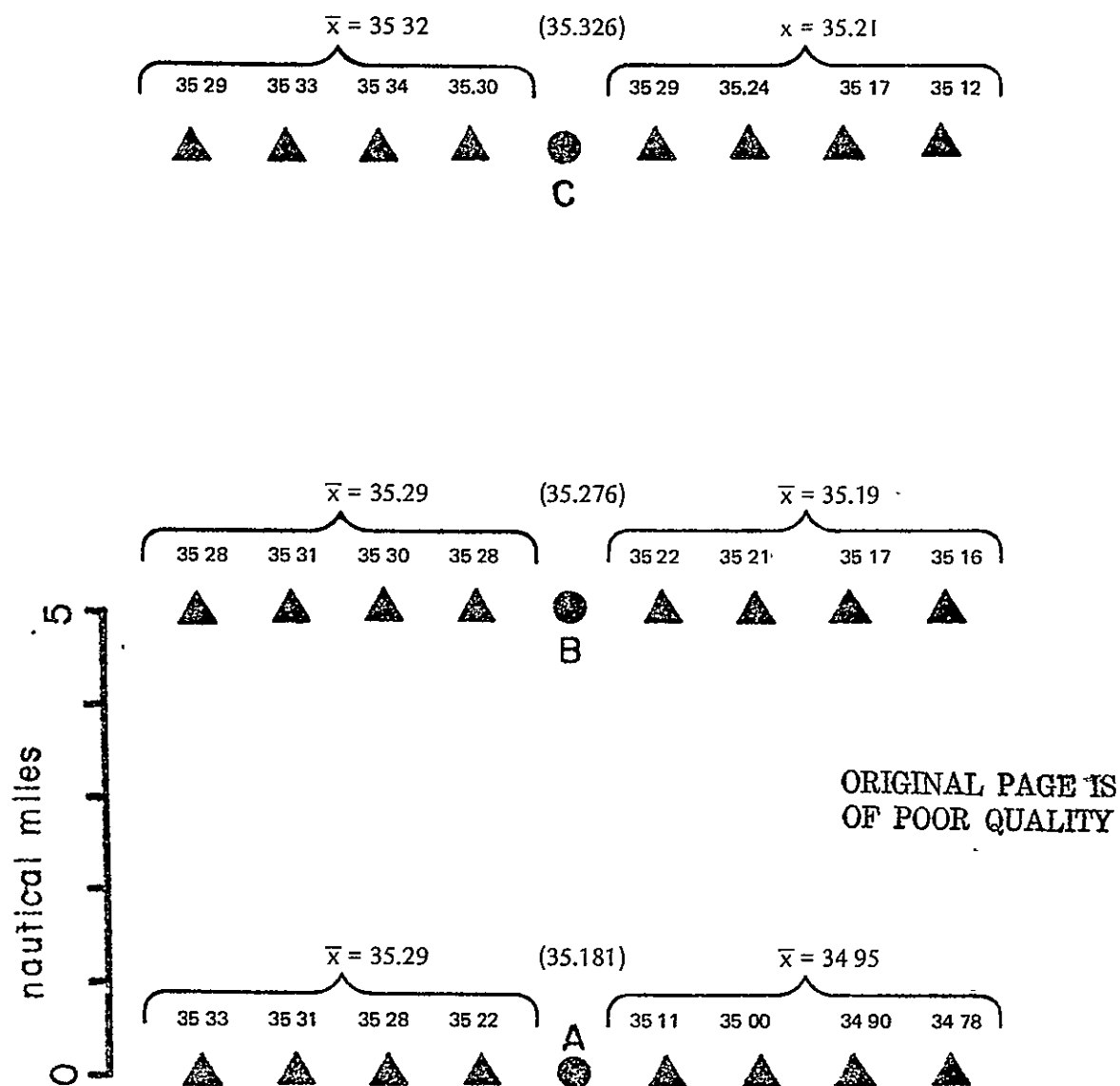


FIG. 3-a SURFACE AND VERTICAL DISTRIBUTION OF SALINITY (‰) AT STATION II.

Temperature (Fig. 3-b)

The distribution of surface temperatures at the positions occupied showed only slight differences. Minor temperature changes were observed in the shallow water columns studied (0-10 m).

Euphotic Zone (Fig. 3-c)

The depth of the euphotic zone at Array A is shallower than at Arrays B and C. The euphotic zones at the positions occupied by the Zodiac(R) were generally shallower than those occupied by the Zodiac(L).

Chlorophyll a (Fig. 3-d)

While the CALYPSO chlorophyll a surface data were the same (0.53 mg/m^3) at positions A, B and C, one notes from the above figure that the Zodiacs(R) chlorophyll data were, in general, higher than those collected by Zodiac(L). This seems to correspond well with the Secchi disc readings of the two Zodiacs. The vertical distributions of chlorophyll a at A, B and C show a tendency to increase with depth.

Nutrients (Figs. 3-e, f and g)

Phosphate samples taken by Zodiac(R) at Arrays A and B showed higher concentrations than those taken by Zodiac(L). However, average phosphates at Array C gave similar values for both Zodiacs. Phosphate values in the upper 10 m showed slight variations from those at the surface.

Silicate values, on the average, showed marked increase between Arrays A, B and C. The CALYPSO surface samples clearly reflected this increase. Surface silicates values at A and C decreased between surface and 5 m; this was followed by an increase between 5 and 10 m.

● = CALYPSO stations

▲ = Zodiac stations

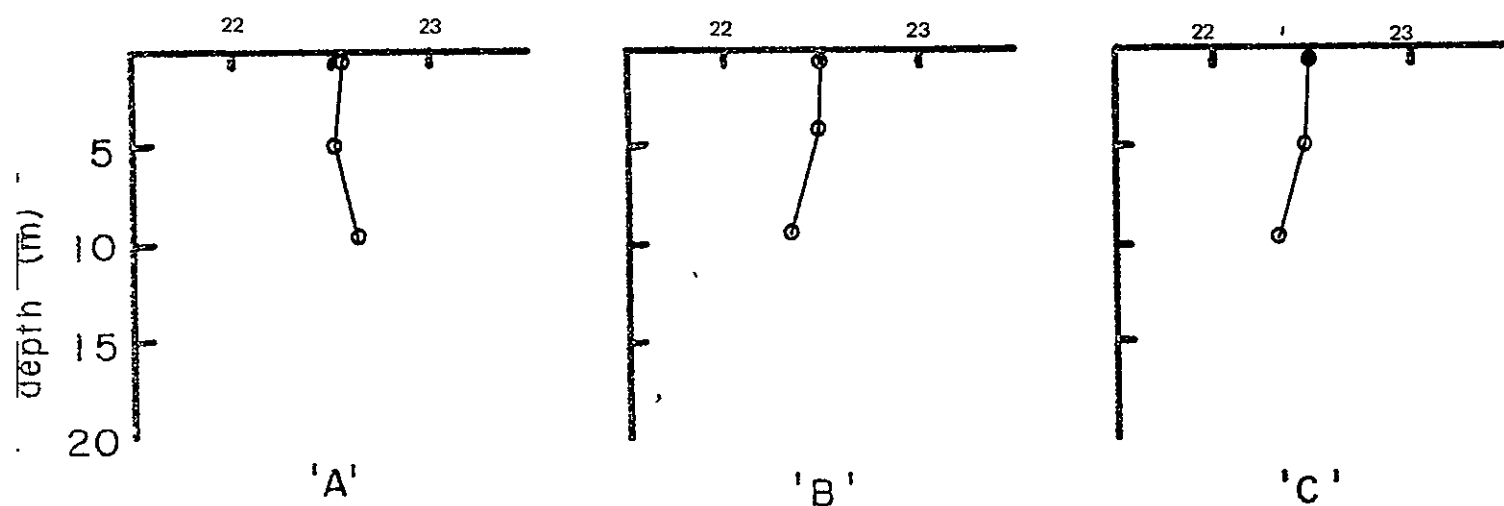
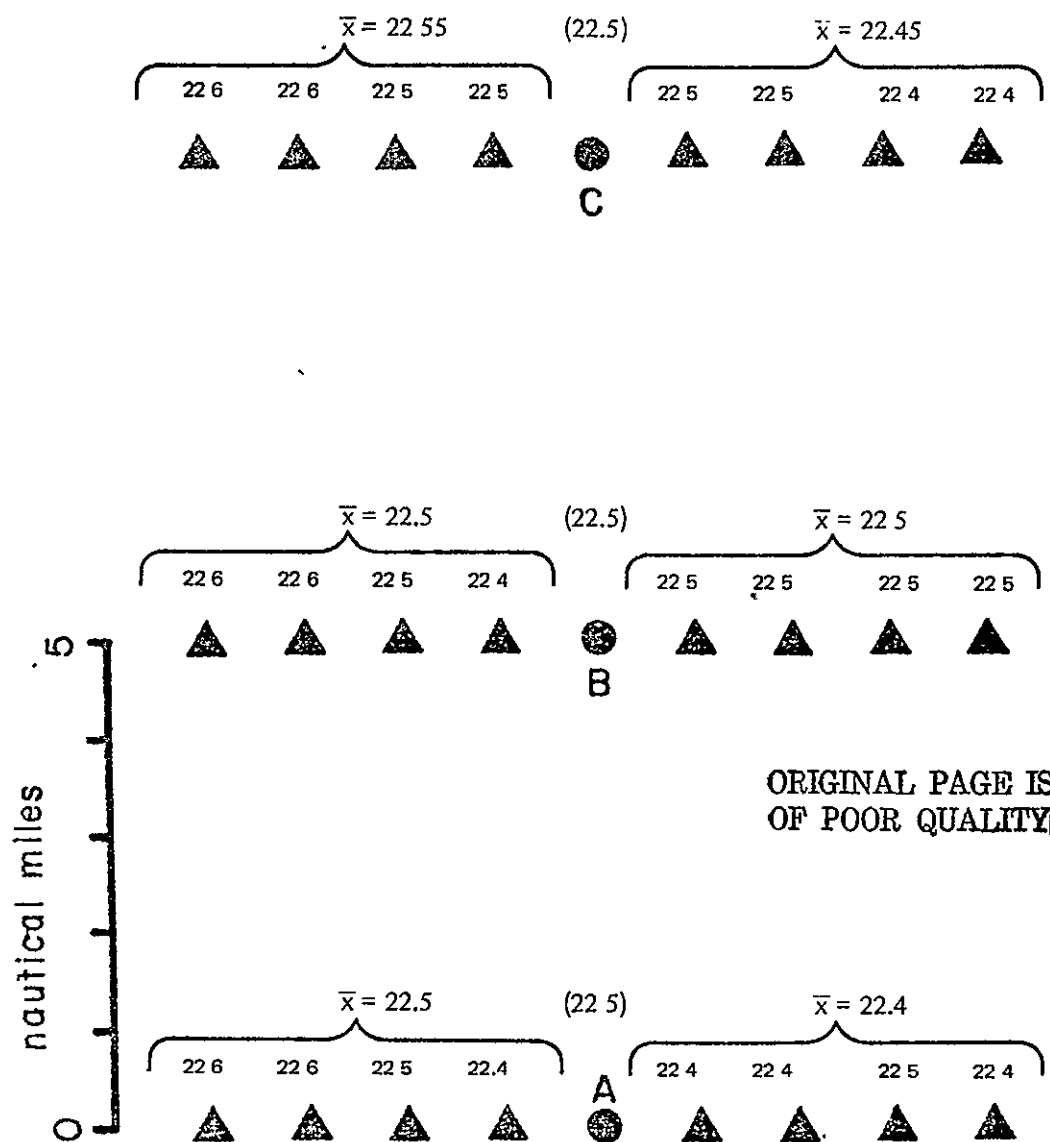


FIG. 3-b SURFACE AND VERTICAL DISTRIBUTION OF TEMPERATURE ($^{\circ}\text{C}$) AT STATION II.

● = CALYPSO stations

▲ = Zodiac stations

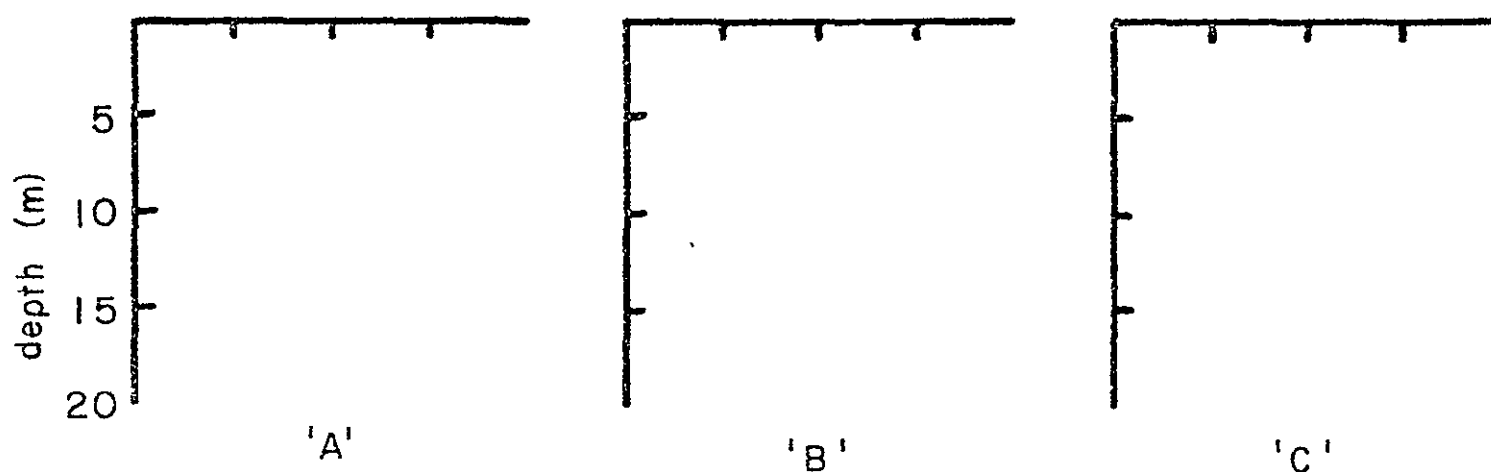
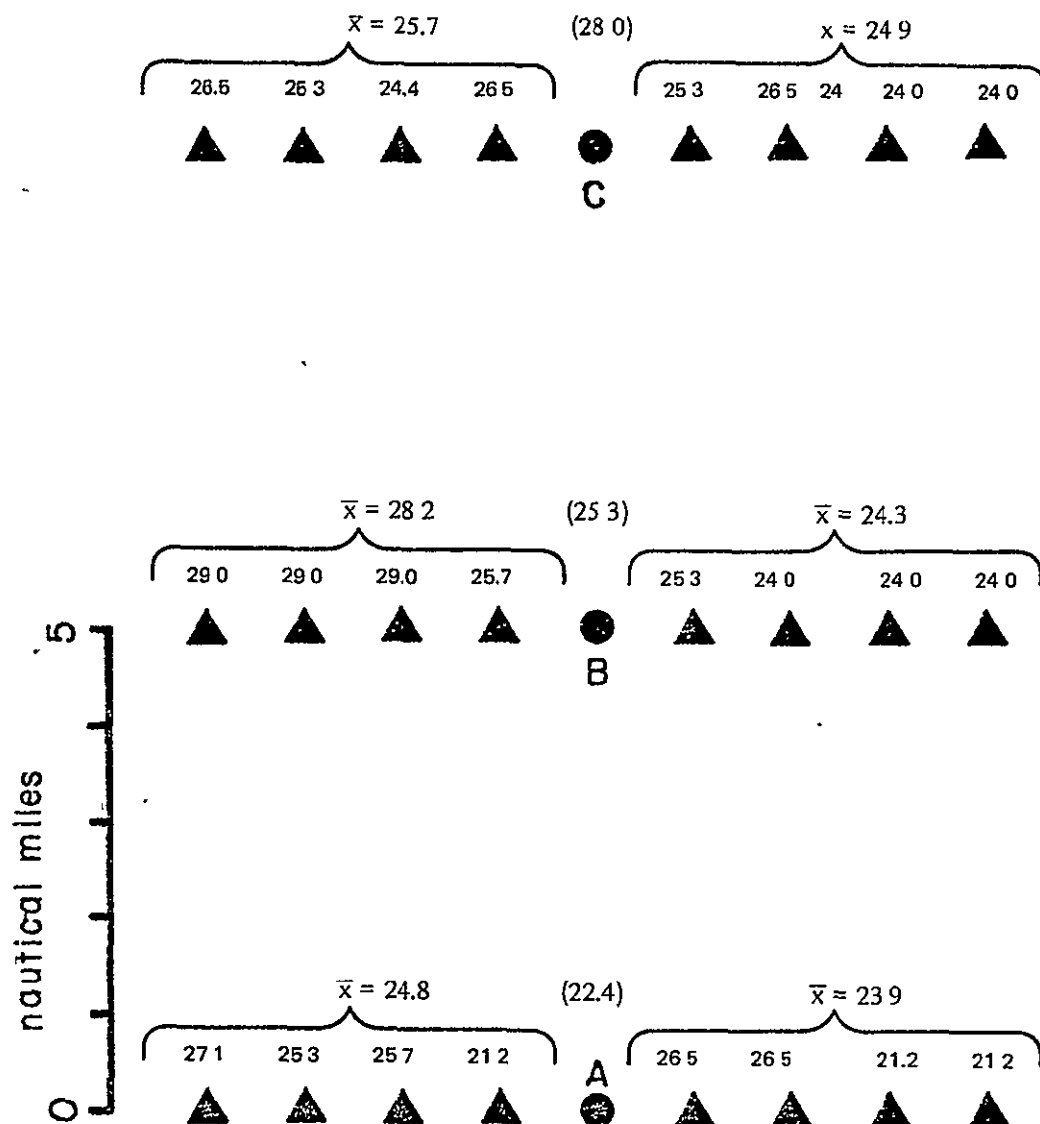


FIG. 3-c SURFACE AND VERTICAL DISTRIBUTION OF EUPHOTIC ZONE (m) AT STATION II.

● = CALYPSO stations

▲ = Zodiac stations

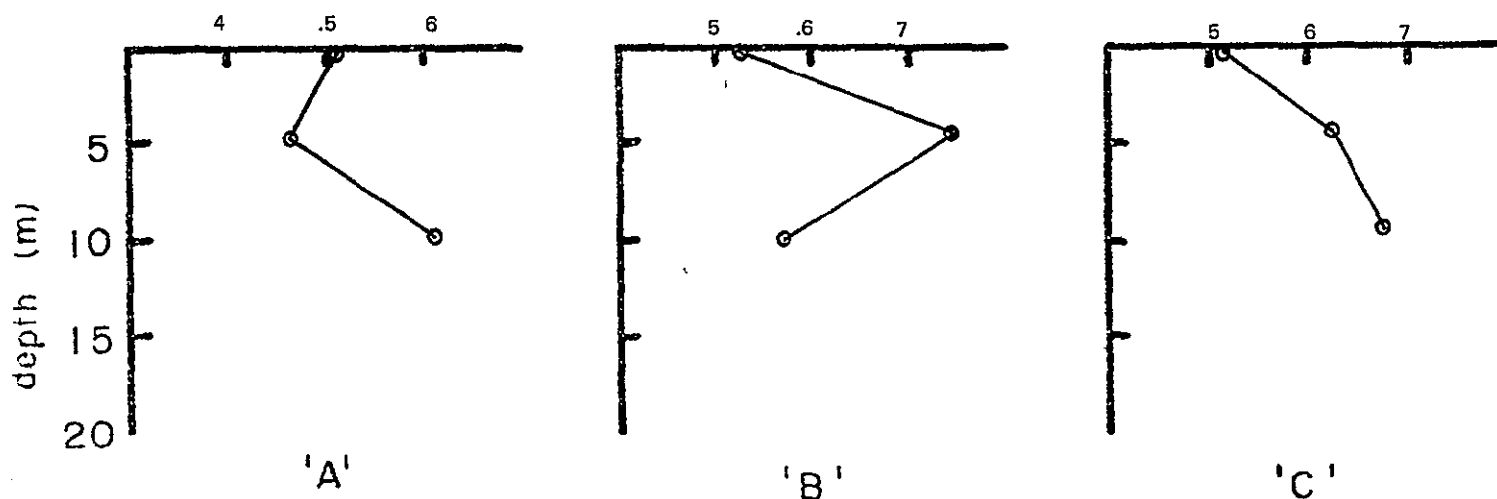
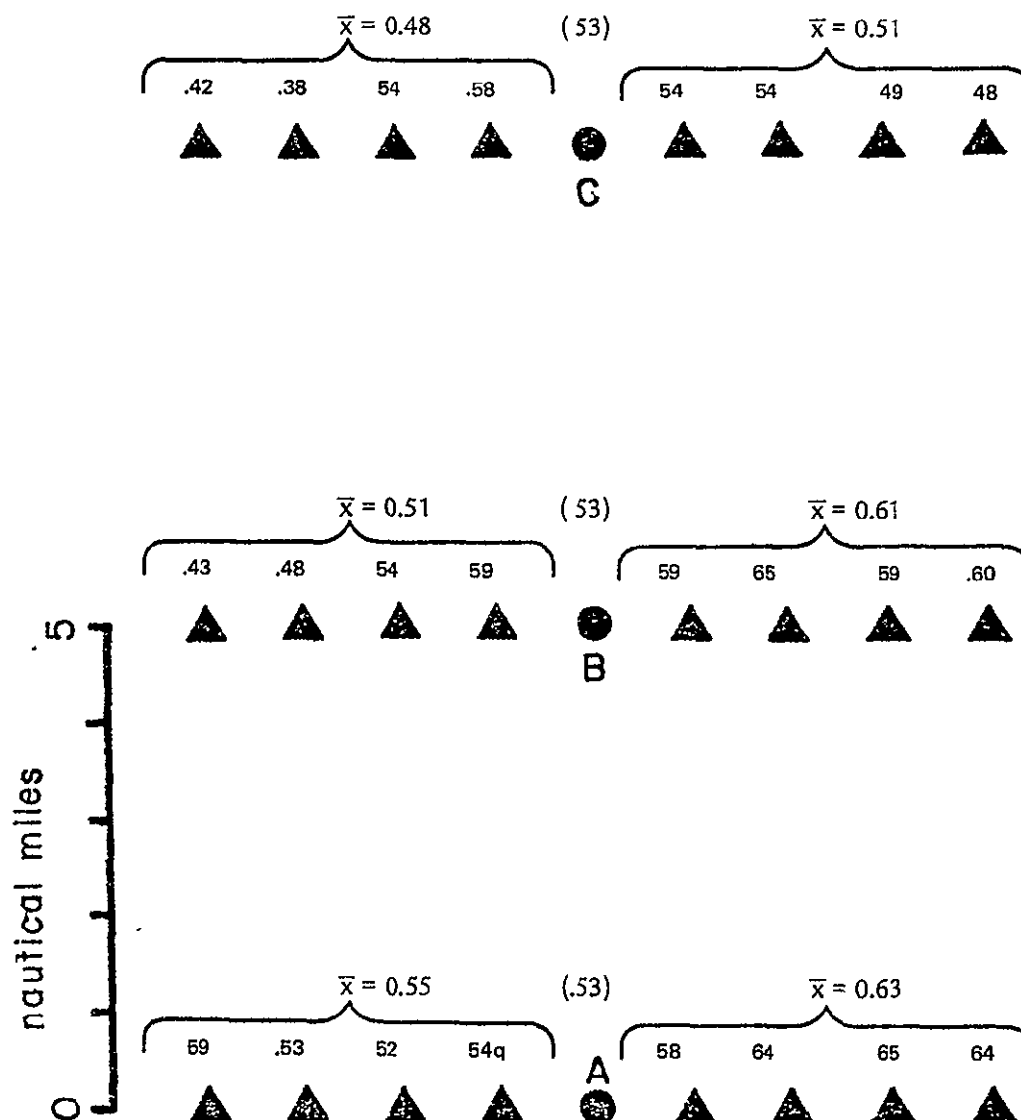


FIG. 3 -d SURFACE AND VERTICAL DISTRIBUTION OF CHLOROPHYLL A (mg/m^3) AT STATION II.

● = CALYPSO stations

▲ = Zodiac stations

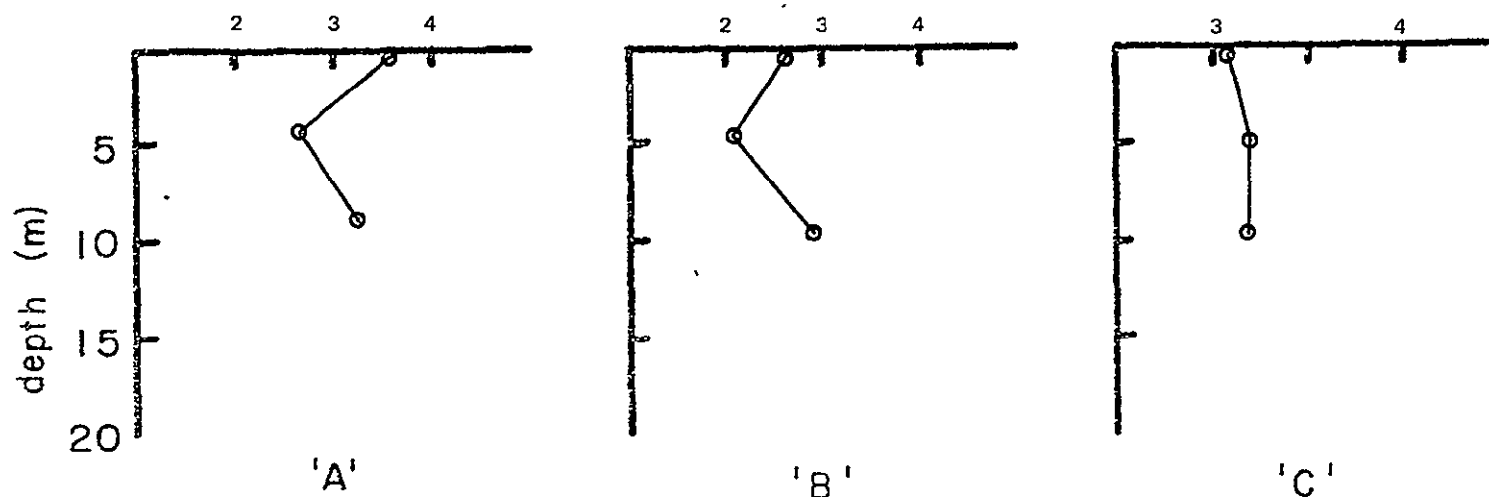
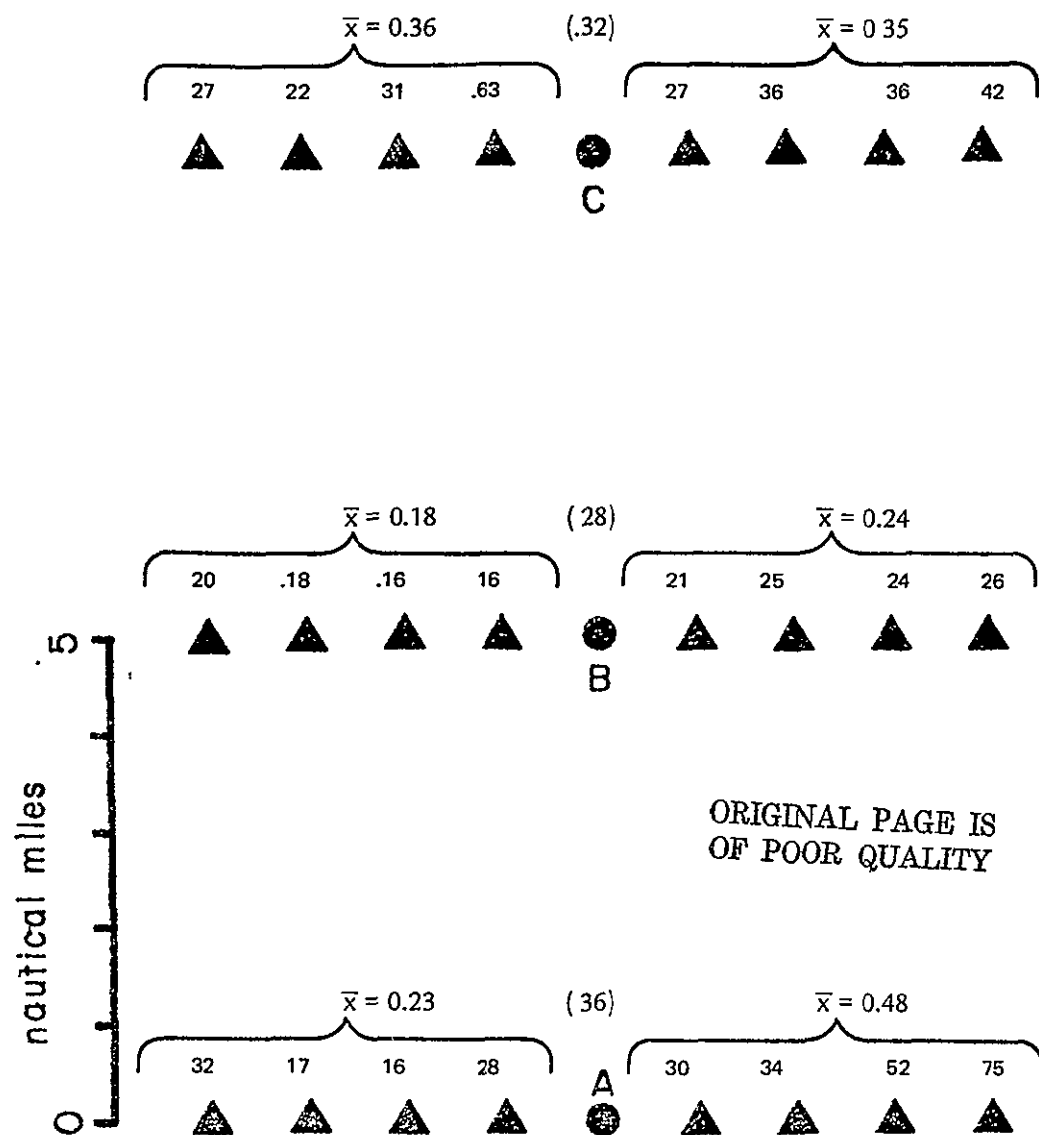


FIG. 3-e SURFACE AND VERTICAL DISTRIBUTION OF PHOSPHATE ($\mu\text{g.at/L}$) AT STATION II.

● = CALYPSO stations

▲ = Zodiac stations

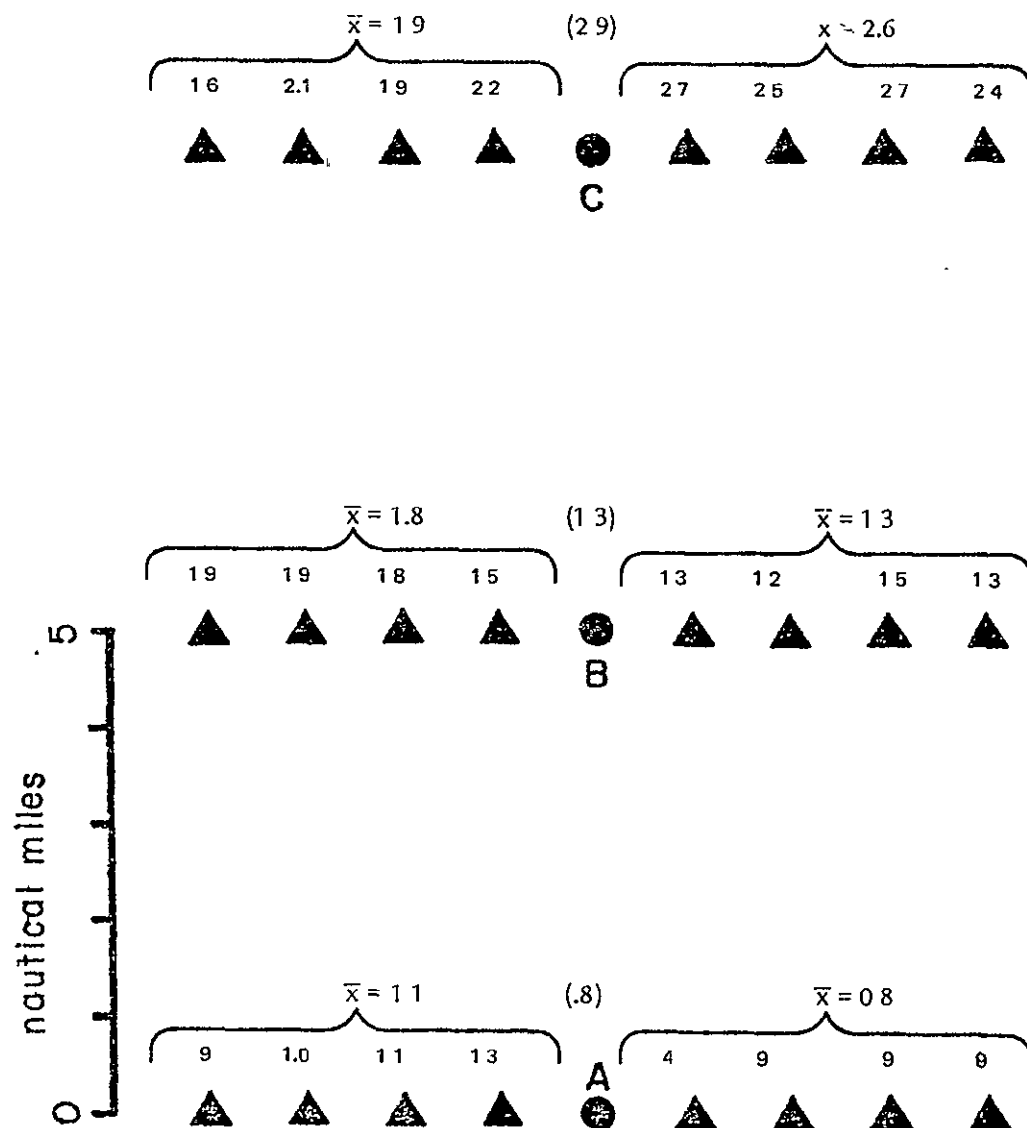
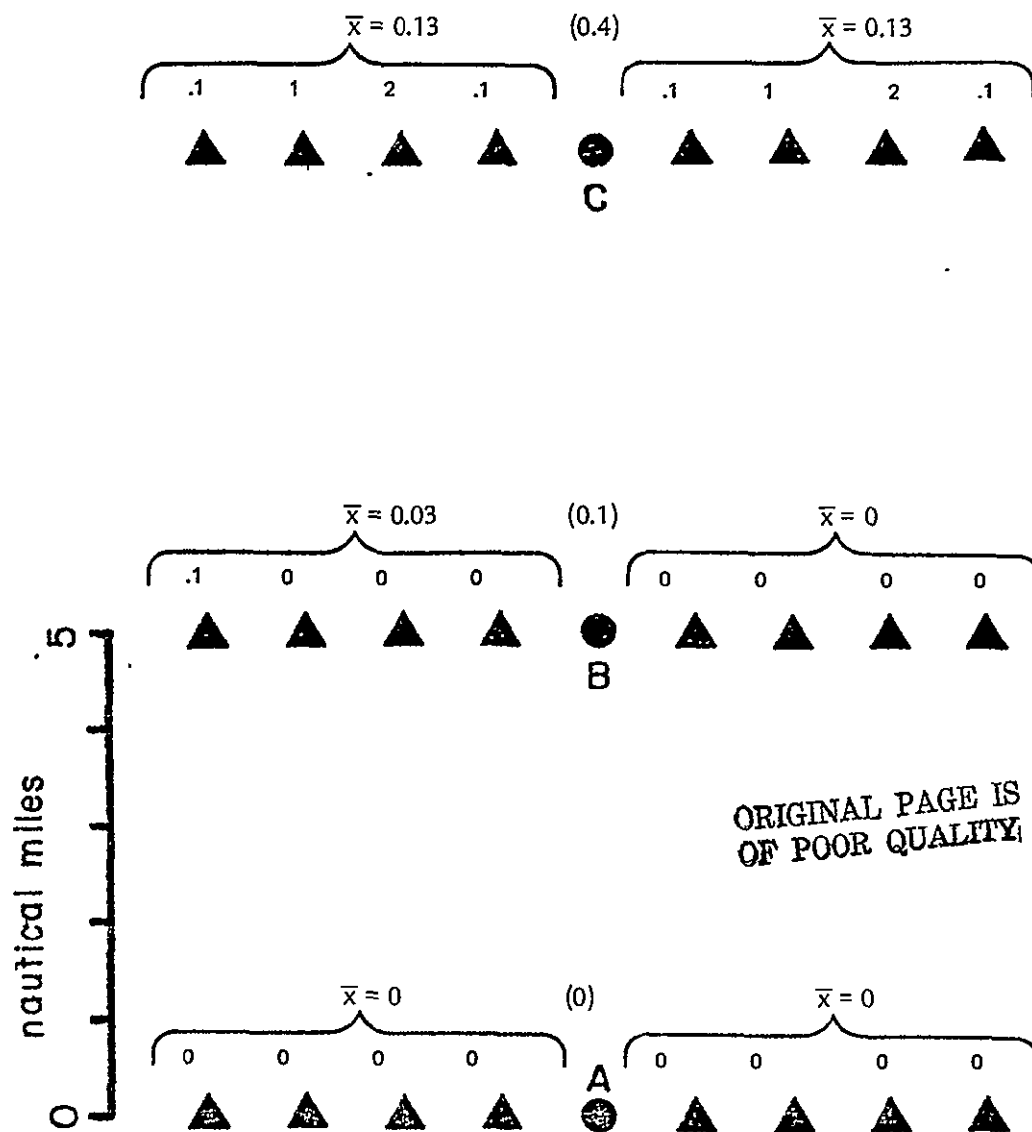


FIG. 3-f. SURFACE AND VERTICAL DISTRIBUTION OF SILICATE ($\mu\text{g.at/L}$) AT STATION II.

● = CALYPSO stations

▲ = Zodiac stations



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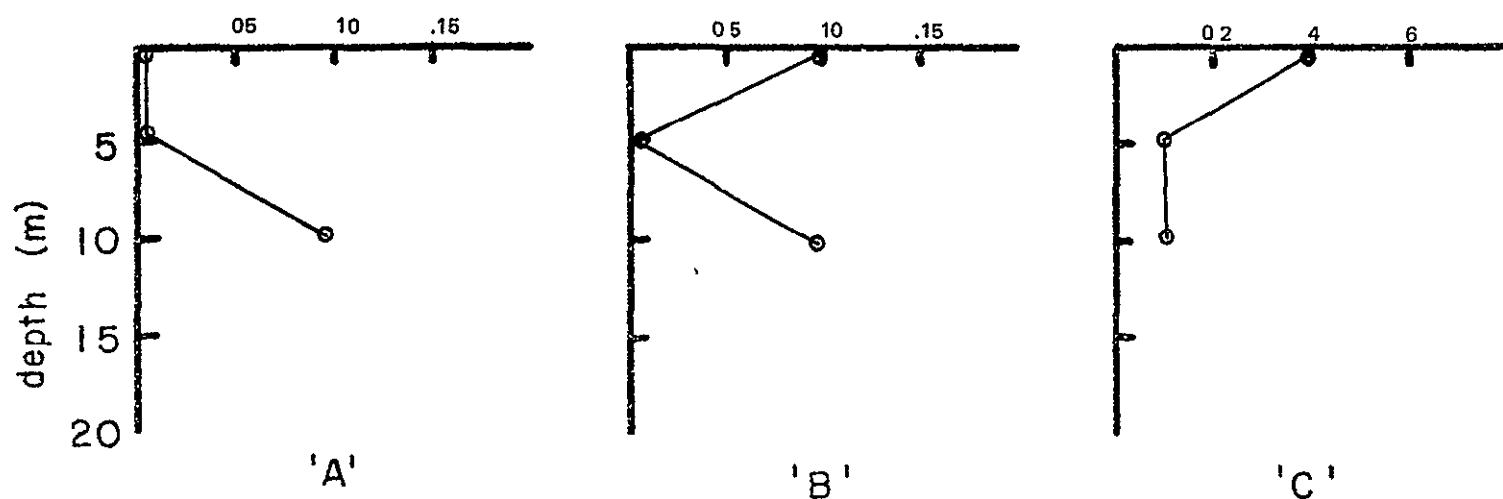


FIG. 3-g SURFACE AND VERTICAL DISTRIBUTION OF NITRATE ($\mu\text{g.at/L}$) AT STATION II.

Nitrate values showed a trend similar to that of silicates; namely a marked increase in value between Arrays A, B and C.

Station III

This station was occupied off Panama City, Florida, on November 13, 1974.

Salinity (Fig. 4-a)

Only slight salinity variations were noted between the CALYPSO and Zodiac stations. The above figure also shows minor salinity changes in the shallow water columns studied (0-15 m) at positions A, B and C.

Temperature (Fig. 4-b)

In general, sea-surface temperatures recorded at Array A were lower than those recorded at either Array B or C. The temperatures recorded by the two Zodiacs did not vary appreciably from those of the CALYPSO at the three arrays studied. The vertical distribution of temperature at the three CALYPSO positions (A, B and C) showed minor changes with depth.

Euphotic Zone (Fig. 4-c)

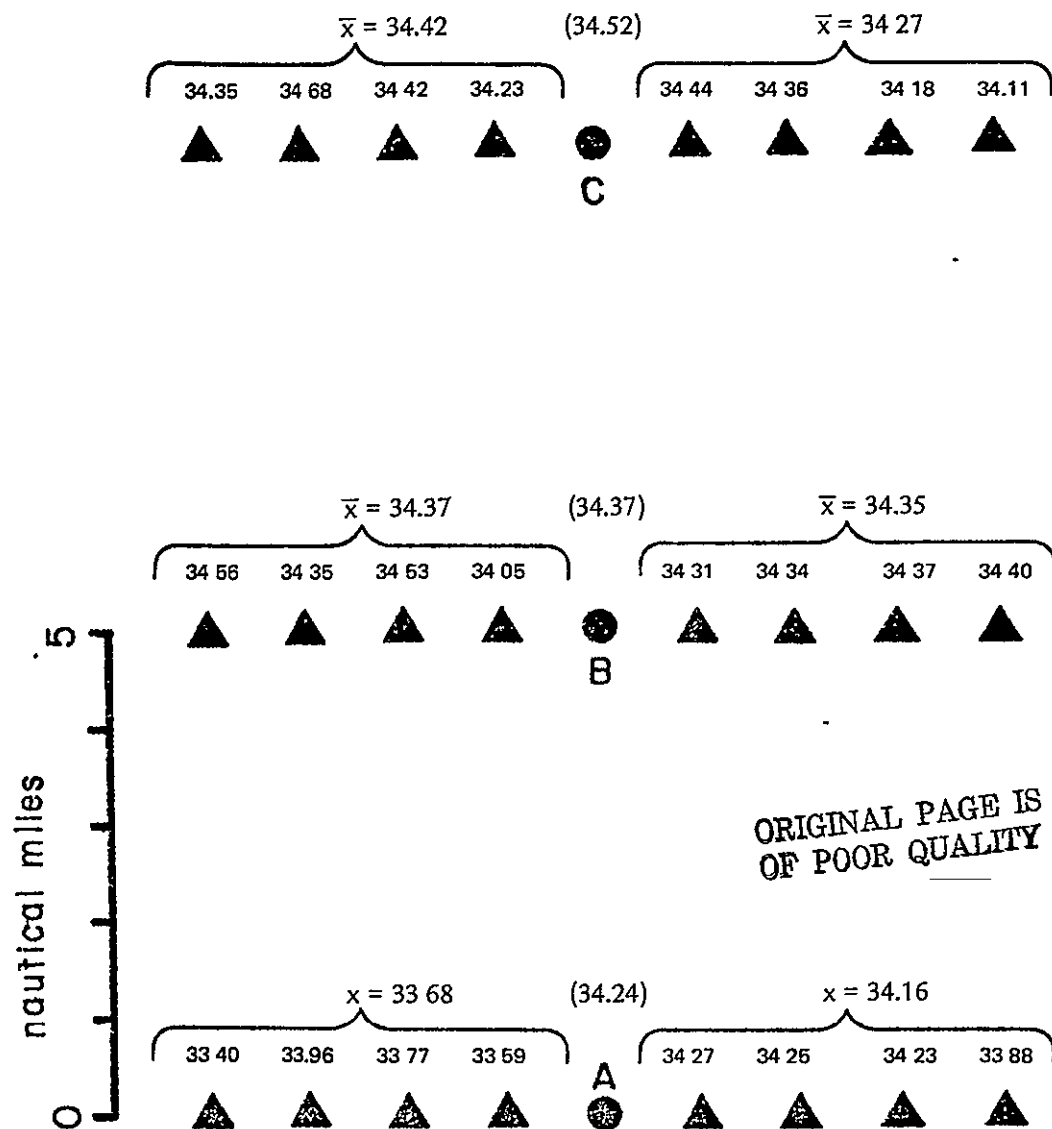
The depths of the euphotic zone varied appreciably between the three arrays. Array A displayed the shallowest euphotic zones of the whole region; and that of the CALYPSO(A) was the shallowest of them all (10 m). Although Arrays B and C gave more or less comparable values, those of B were deeper than the C positions. One also notes from the above figure that the depths of the euphotic zones of the Zodiac(R) regions were shallower than those of Zodiac(L).

Chlorophyll a (Fig. 4-d)

The depths of the euphotic zones (see above) seem to reflect the concentrations of the phytoplankton standing crop (in terms of chlorophyll a). Thus we see in the above figure that the relatively high chlorophyll a concentrations at the positions occupied in Array A, do reflect the shallowness of the euphotic zones at the CALYPSO and Zodiac positions. Chlorophyll a values

● = CALYPSO stations

▲ = Zodiac stations



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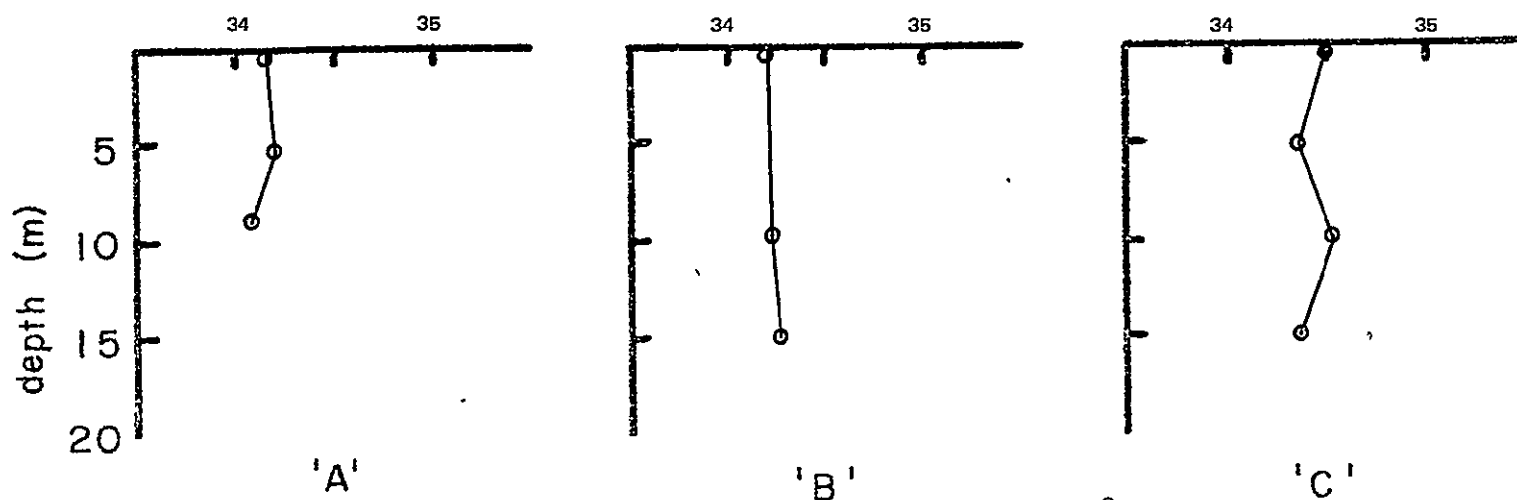


FIG. 4-a SURFACE AND VERTICAL DISTRIBUTION OF SALINITY ($^{\circ}/_{\infty}$) AT STATION III.

● = CALYPSO stations

▲ = Zodiac stations

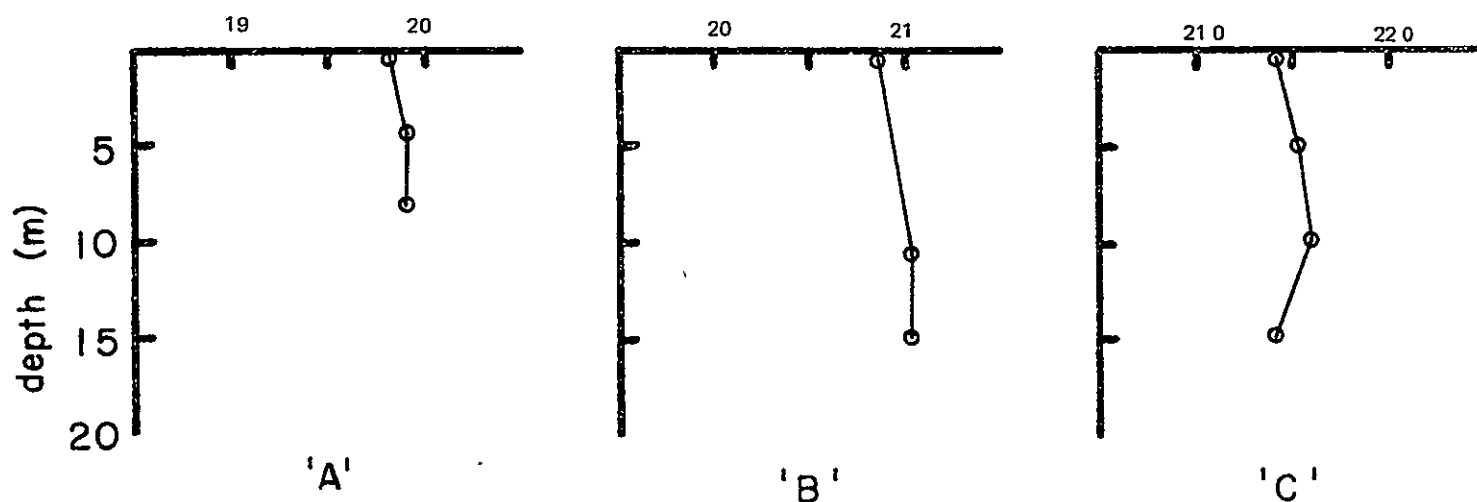
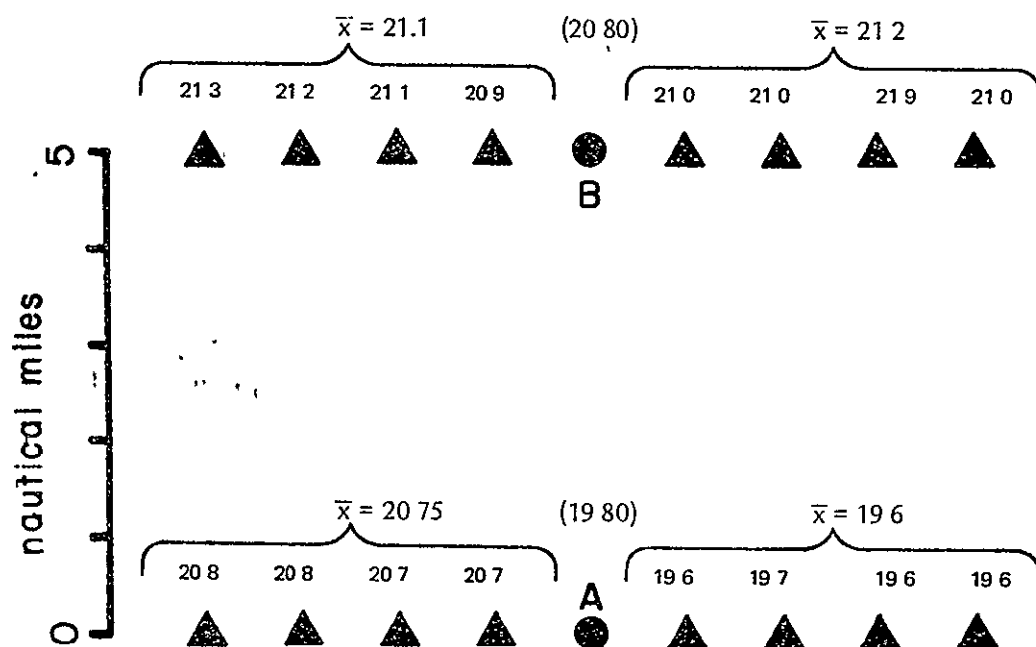
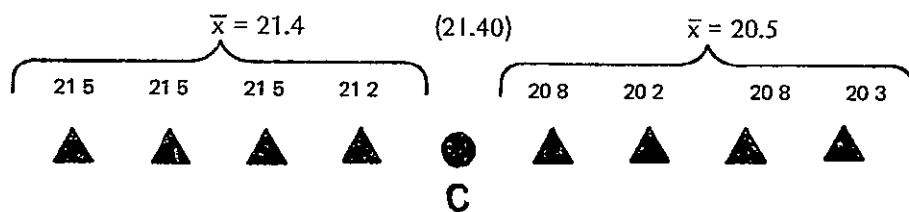


FIG. 4-b SURFACE AND VERTICAL DISTRIBUTION OF TEMPERATURE ($^{\circ}\text{C}$) AT STATION III.

● = CALYPSO stations

▲ = Zodiac stations

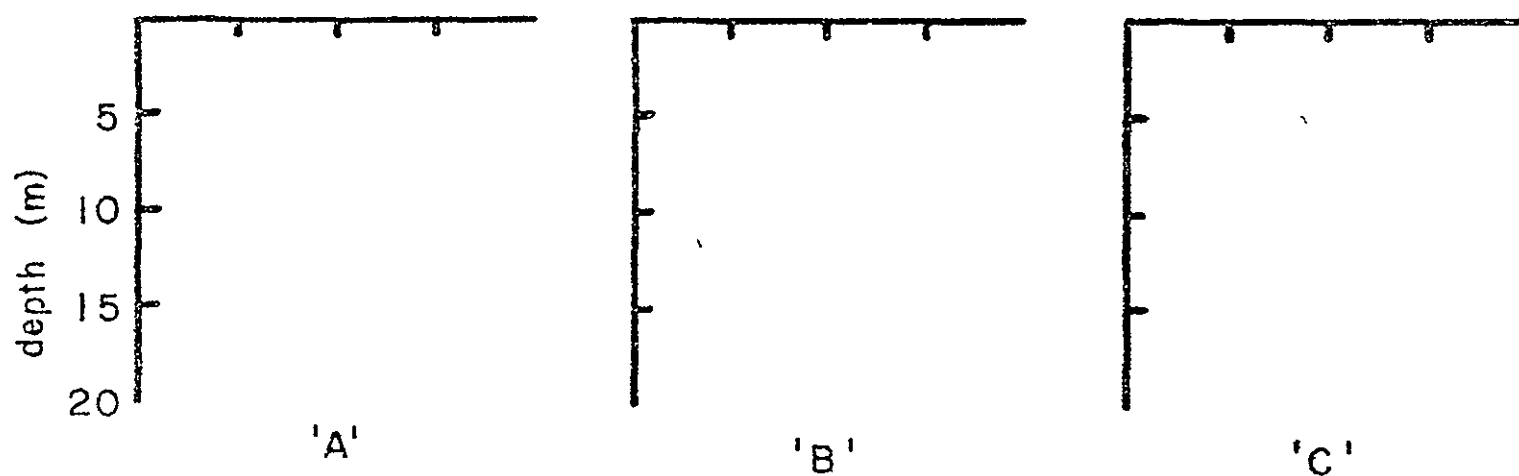
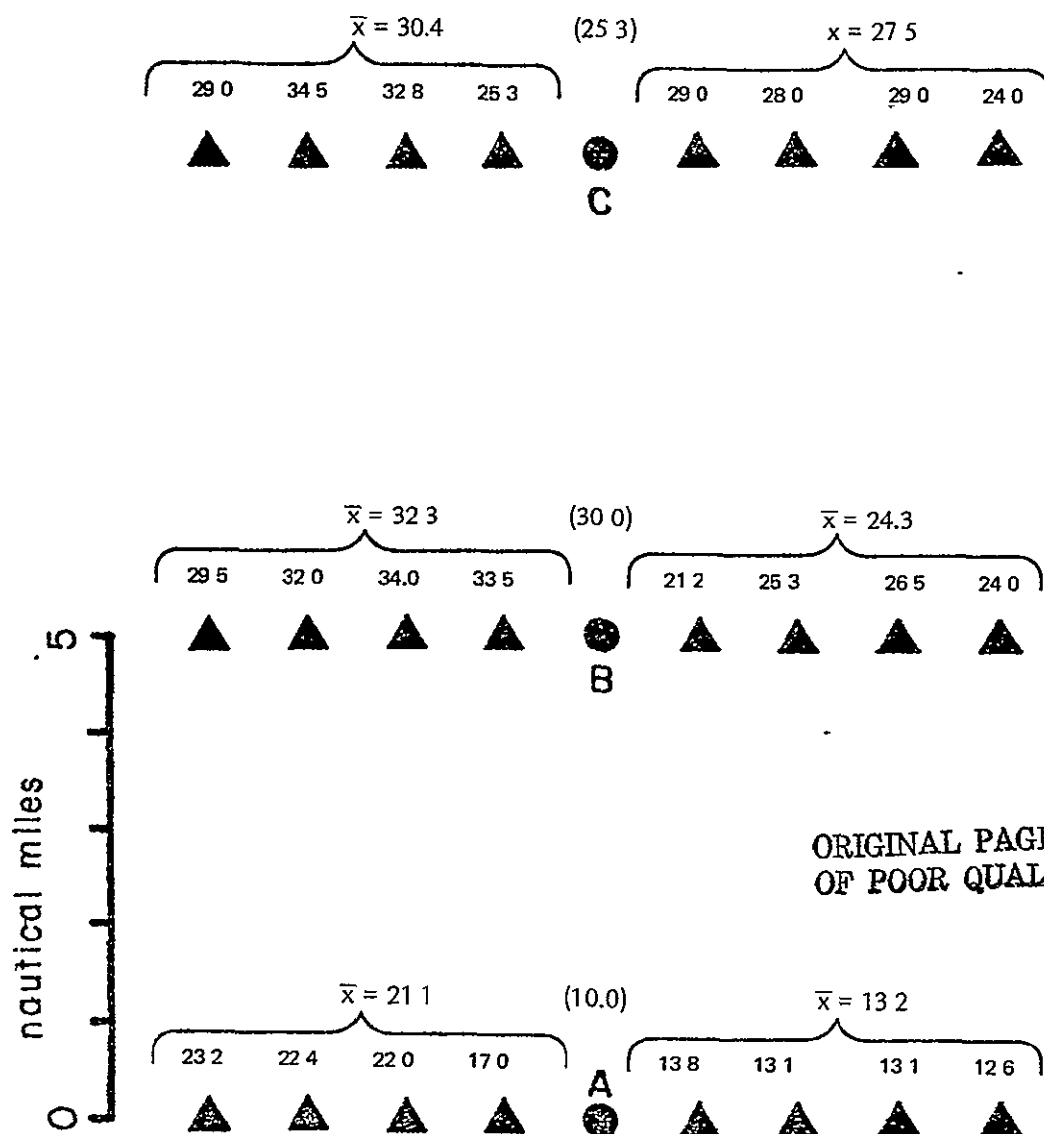


FIG. 4 -c SURFACE AND VERTICAL DISTRIBUTION OF EUPHOTIC ZONE (m) AT STATION III.

● = CALYPSO stations

▲ = Zodiac stations

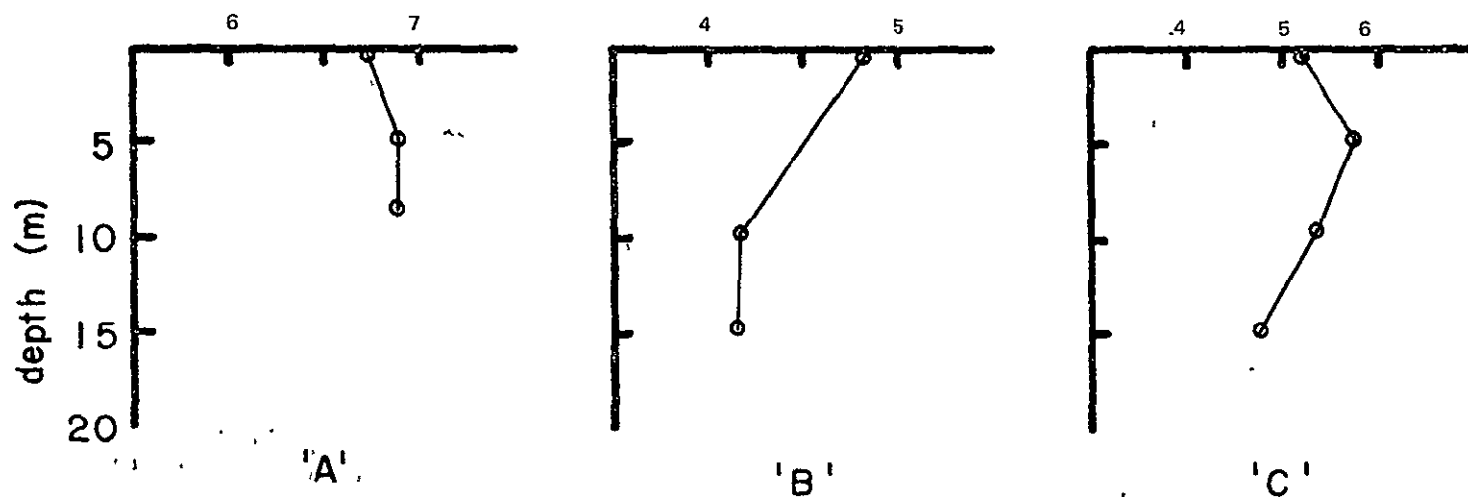
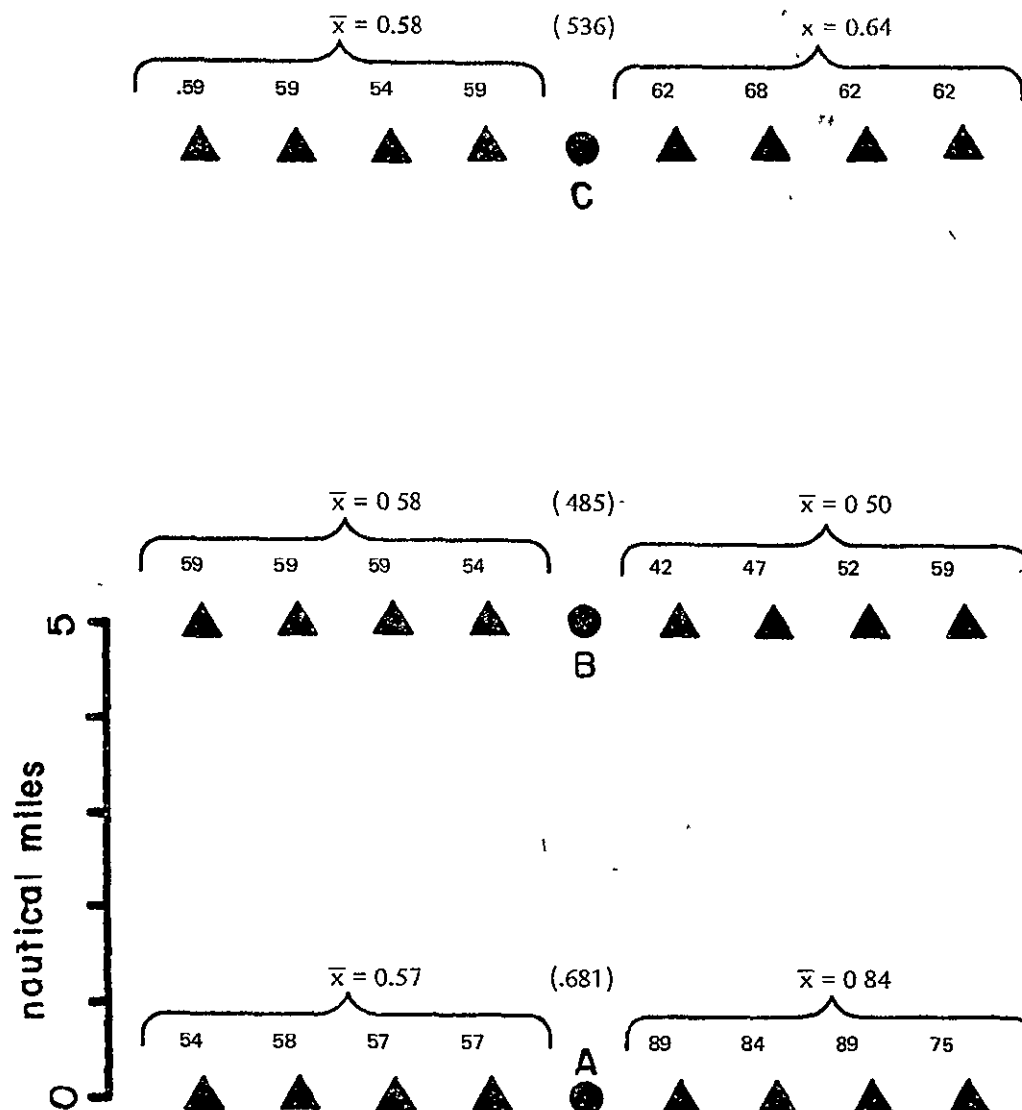


FIG. 4-d SURFACE AND VERTICAL DISTRIBUTION OF CHLOROPHYLL_a(mg/m³) AT STATION III.

at Arrays B and C gave more or less comparable results. Chlorophyll distributions at the three positions occupied by the CALYPSO, showed slight variations with depth.

Nutrients (Figs. 4-e, f, and g)

Phosphate values, on the whole, (Fig. 4 - e) did not vary appreciably between the three arrays; this was especially true for the CALYPSO and Zodiac(L) samples.

Silicate values (Fig. 4-f) showed horizontal and vertical distributions similar to those of phosphates.

Nitrate values (Fig. 4-g) show no clear cut trend in either the horizontal or vertical distributions of nitrates.

Station IV

This station was occupied on November 15, 1974, off Timbalier Bay, Louisiana. This station was selected mainly because it was the site of an intensive biological, chemical and physical investigations carried out between June 1972 and January 1974 as part of the Gulf Universities Research Consortium's Offshore Ecology Investigation (O.E.I.) to study the effect of oil platforms on the ecology and productivity of that region (El-Sayed, 1974). At this station, Array A is nearshore and Array C is offshore. Zodiac(R) positions were west; those of Zodiac(L) were east.

Salinity (Fig. 5-a)

Some salinity variations are noted in the surface samples collected by the CALYPSO and the Zodiacs. Salinity values, in general, increased between Arrays A and C. Surface salinity data collected by Zodiac(L) were lower than those collected by Zodiac(R). The vertical distribution of salinity at the three stations occupied by the CALYPSO, showed very little variation with depth.

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● = CALYPSO stations

▲ = Zodiac stations

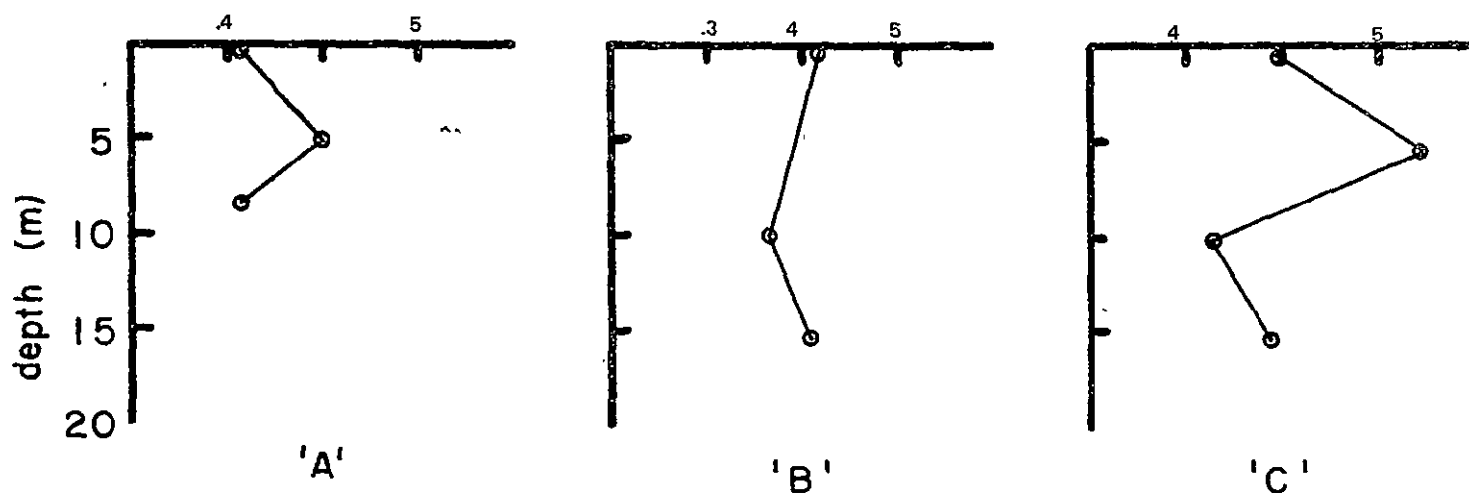
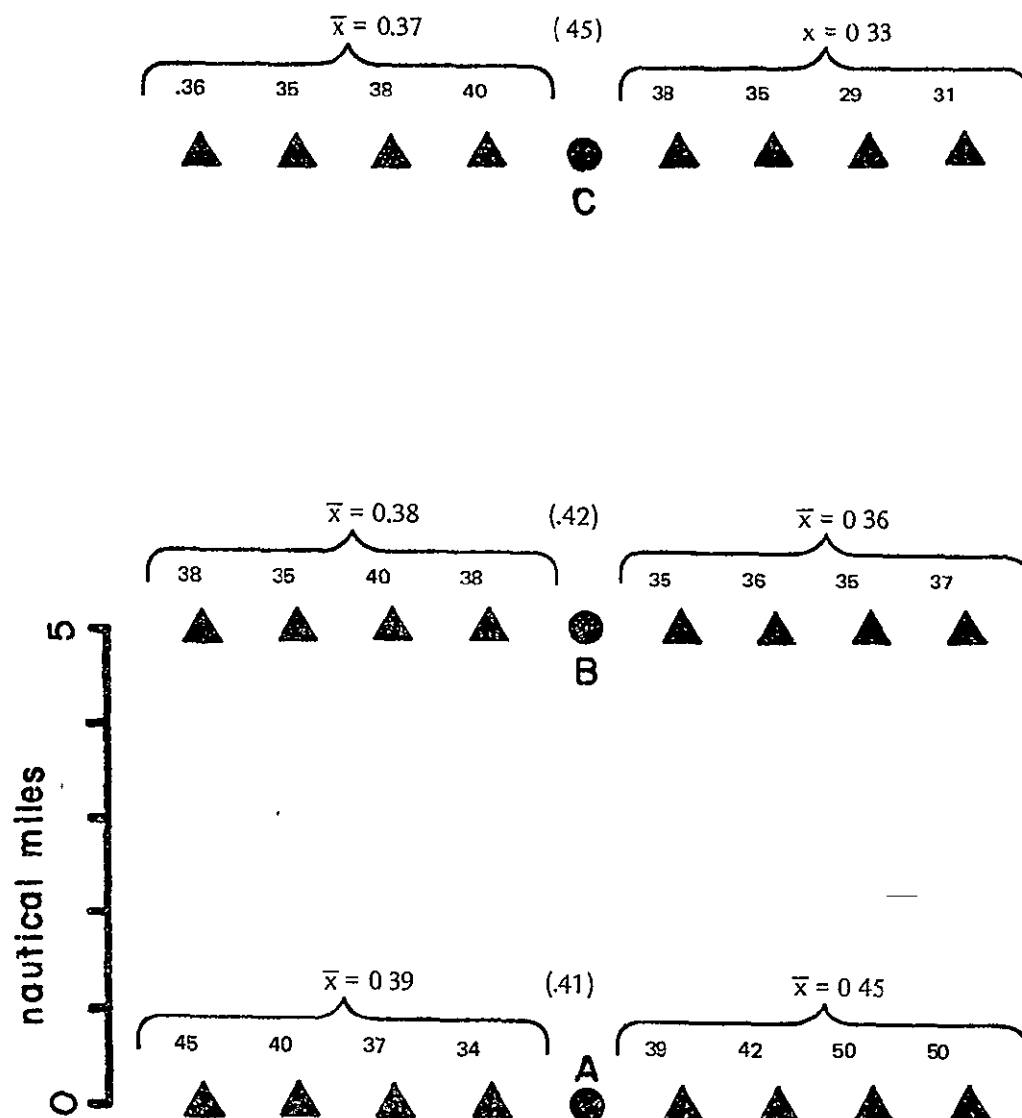
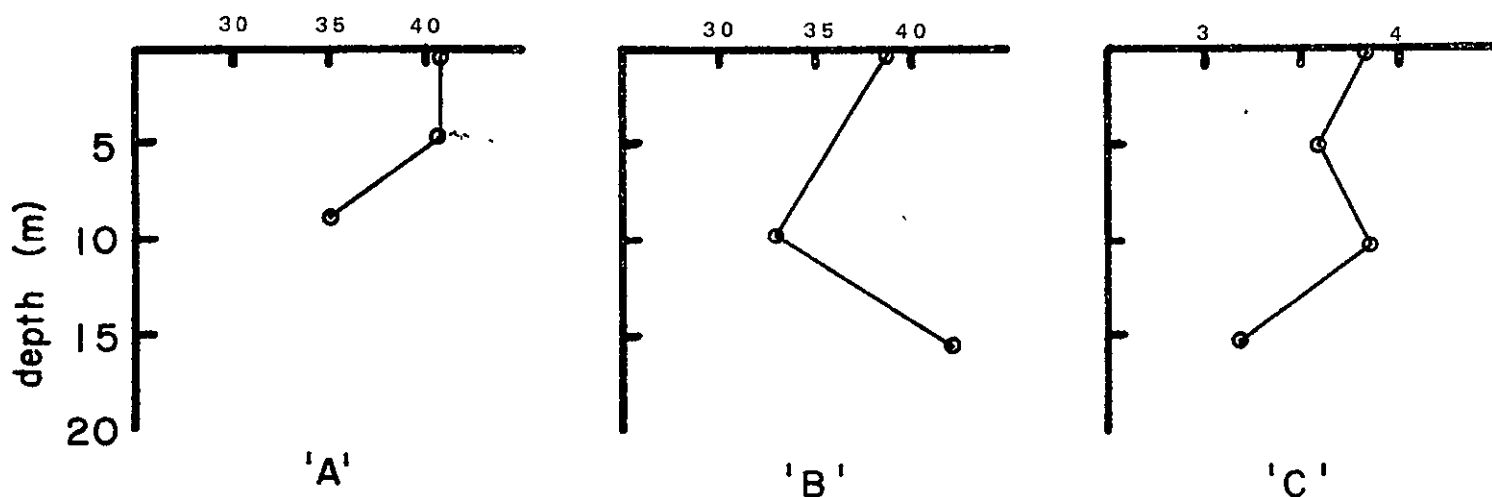
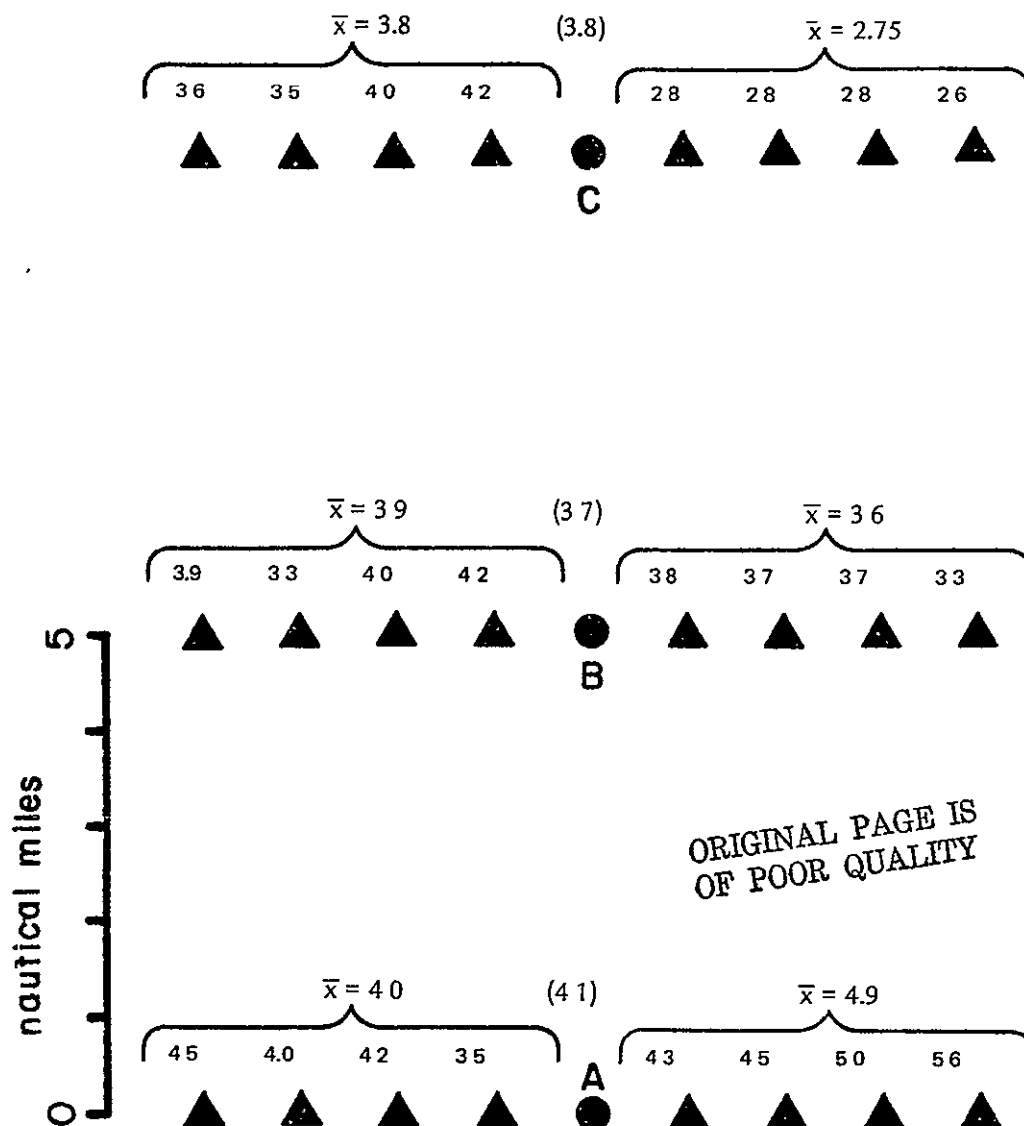


FIG. 4-e SURFACE AND VERTICAL DISTRIBUTION OF PHOSPHATE ($\mu\text{g.at/L}$) AT STATION III.

● = CALYPSO stations

▲ = Zodiac stations

FIG. 4-f SURFACE AND VERTICAL DISTRIBUTION OF SILICATE ($\mu\text{g.at/L}$) AT STATION III.

● = CALYPSO stations

▲ = Zodiac stations

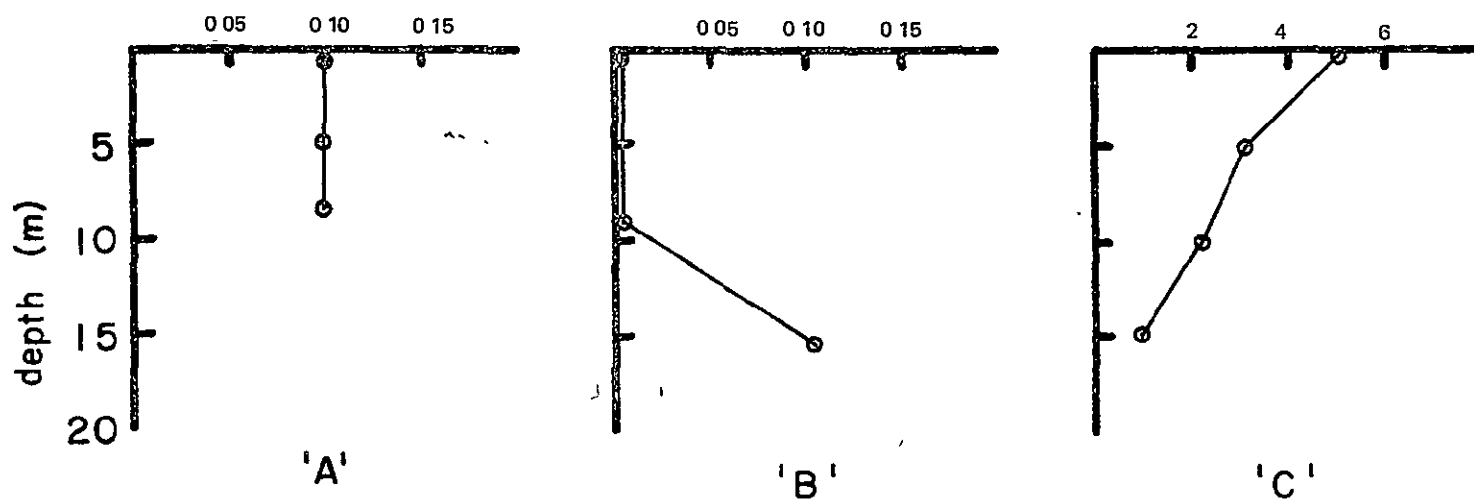
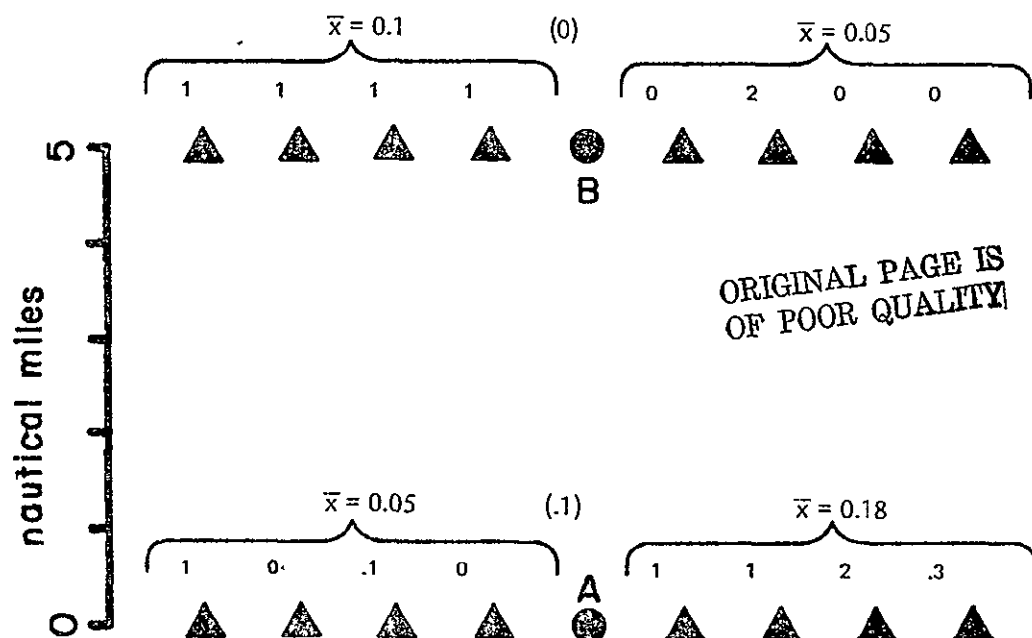
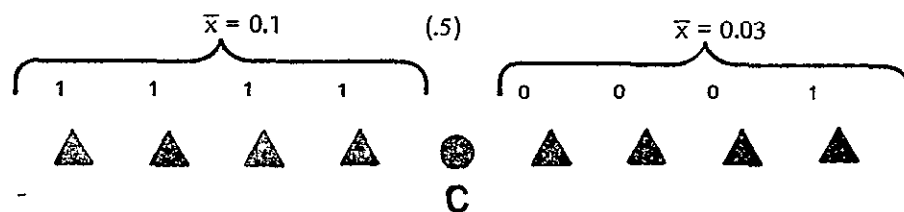


FIG. 4-g SURFACE AND VERTICAL DISTRIBUTION OF NITRATE ($\mu\text{g.at/L}$) AT STATION III.

● = CALYPSO stations

▲ = Zodiac stations

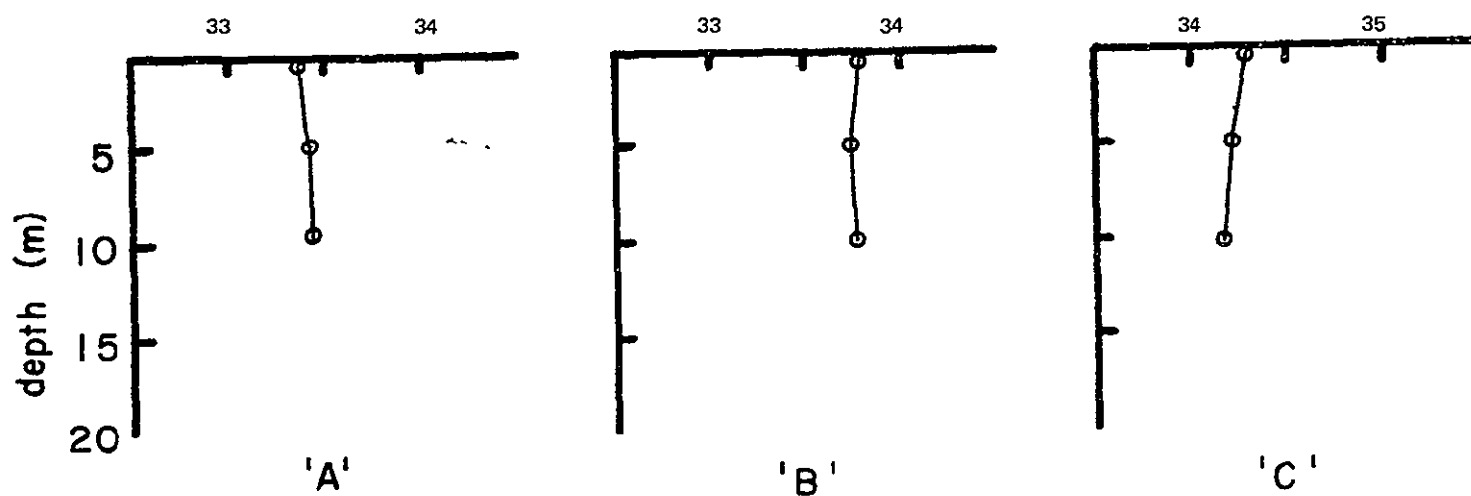
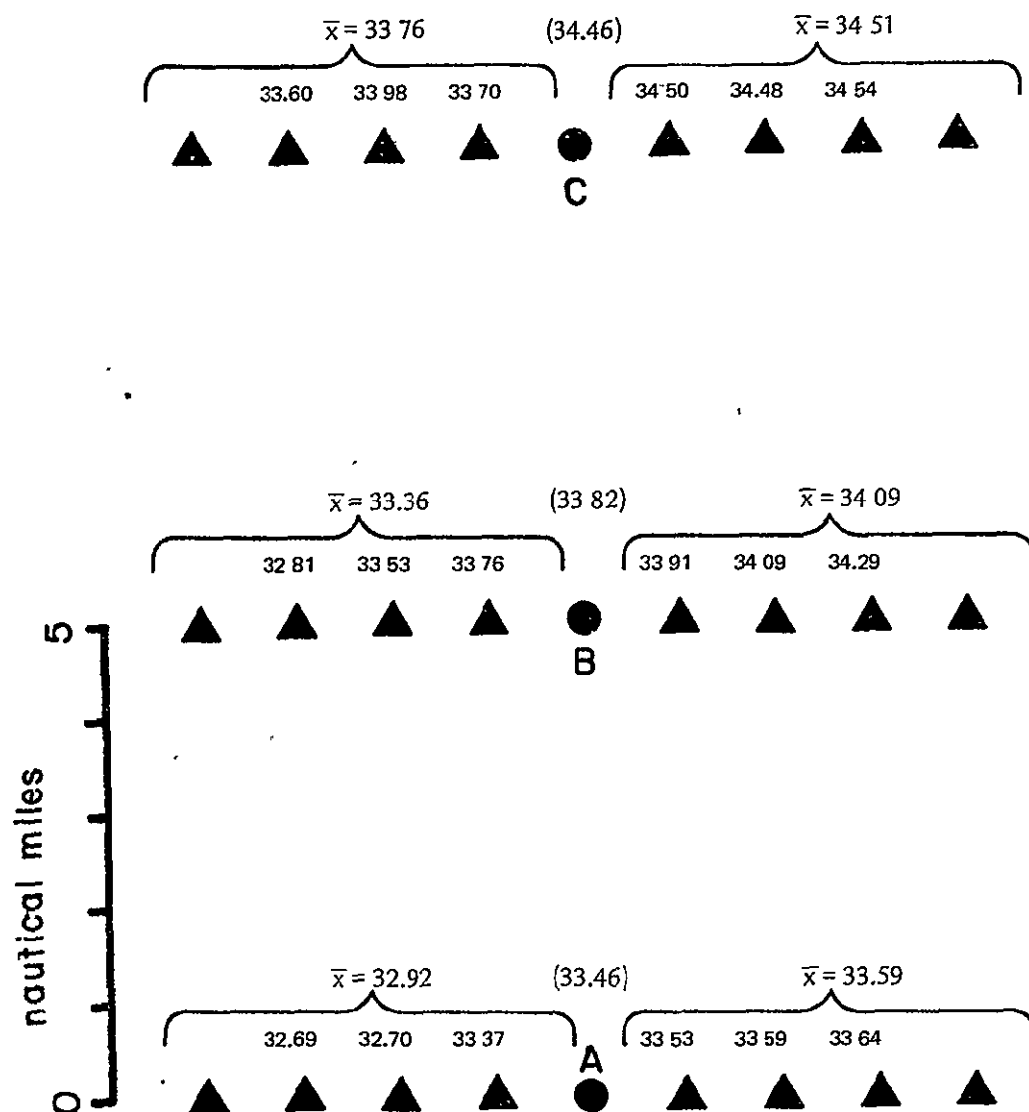


FIG. 5-a SURFACE AND VERTICAL DISTRIBUTION OF SALINITY (‰) AT STATION IV.

Temperature (Fig. 5-b)

As with salinity, sea surface temperature showed slight variations throughout the area studied. Surface temperature recorded by Zodiac(L) were about 0.5°C lower than those recorded by Zodiac(R). Vertical temperature distribution at the CALYPSO stations showed minor changes with depth (between surface and 10 m) at A and C Arrays, and an increase between surface at 5 m at Array B.

Euphotic Zone (Fig. 5-c)

The above figure shows a gradual increase in the depth of the euphotic zone between Array A (inshore; average depth 6 m), Array B (average depth 9.6 m) and Array C (average depth 12 m).

Chlorophyll a (Fig. 5-d)

Some variations in surface chlorophyll a values are noted in the above figure. However, no consistent pattern or trend can be discerned among these values. The vertical distribution of chlorophyll a at the three positions occupied by the CALYPSO does not show a discernible trend, either.

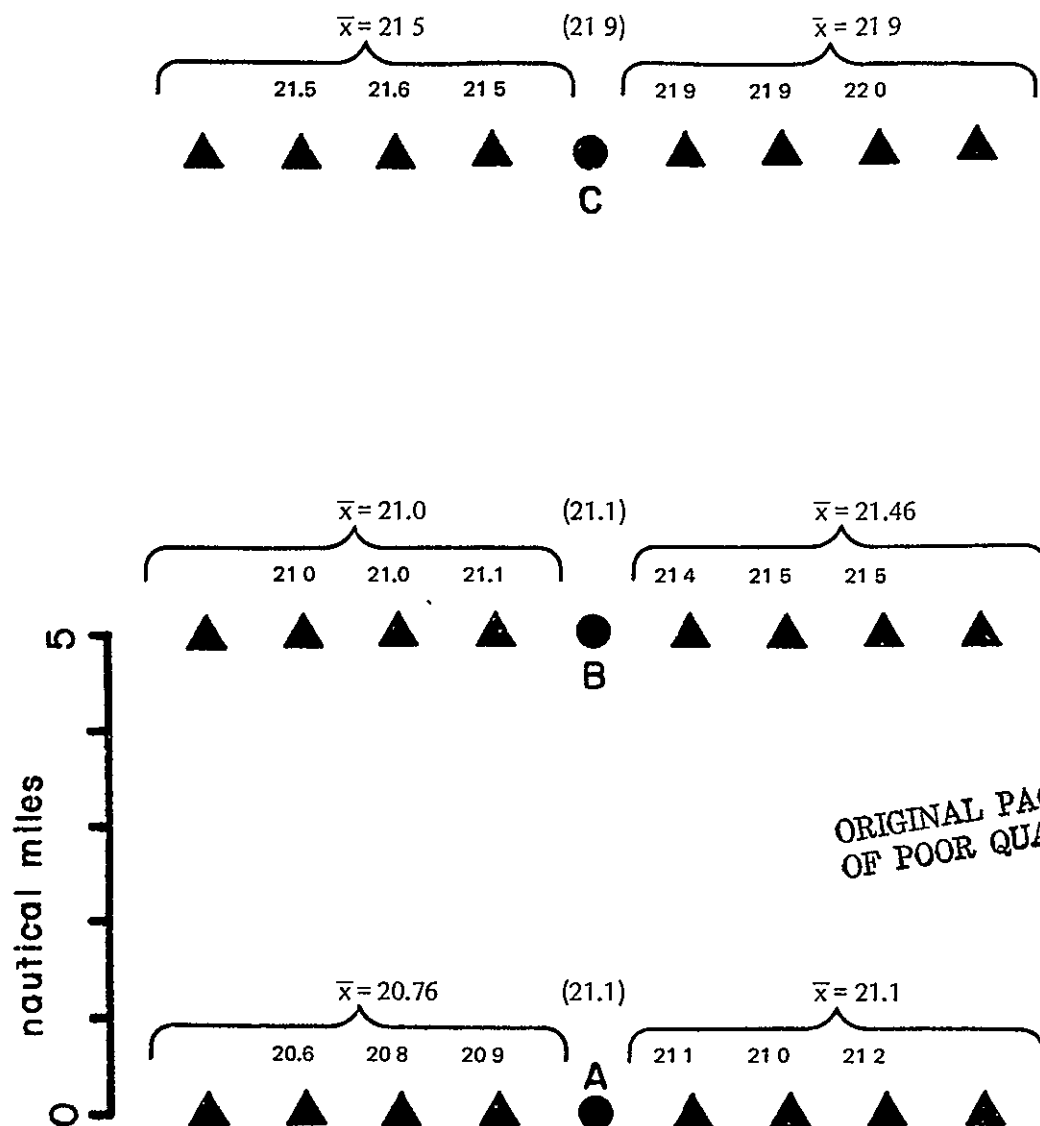
Nutrient Salts (Fig. 5-e, f and g)

Phosphate values recorded at the positions occupied in the Array A were higher than those of B and C. Vertical distribution of phosphate showed an increase between surface and 5 m, then a decrease (except at B) between 5 and 10 m.

Silicate and nitrate distributions (horizontal and vertical) followed much of the same trend as those of the phosphates discussed above (Fig. 5-f and Fig. 5-e).

● = CALYPSO stations

▲ = Zodiac stations



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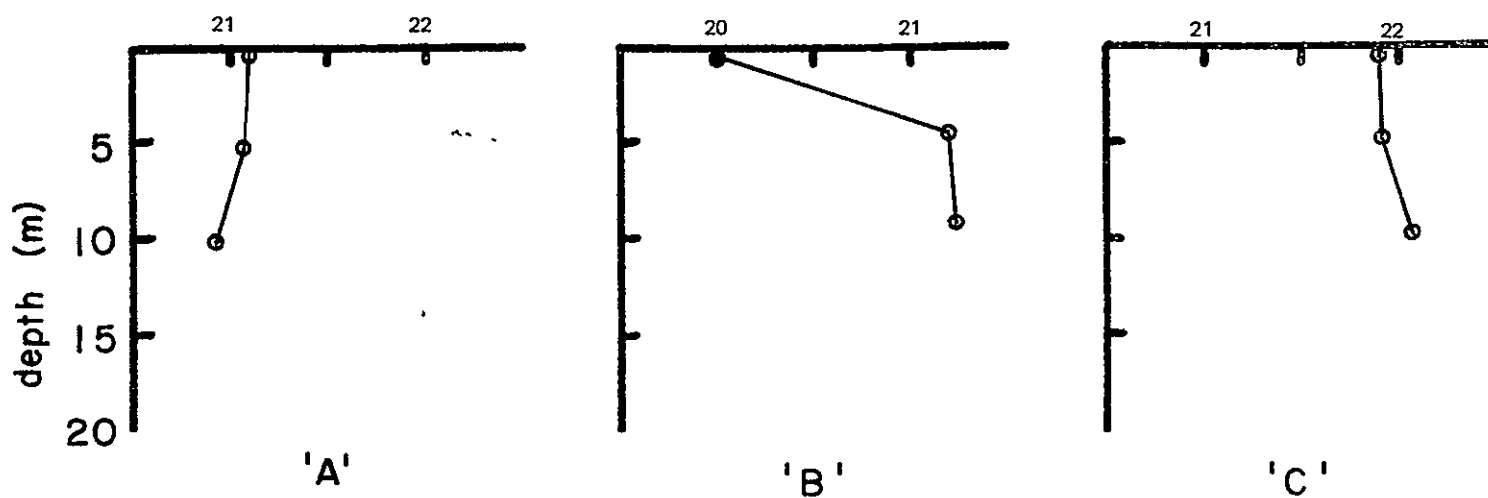


FIG. 5-b SURFACE AND VERTICAL DISTRIBUTION OF TEMPERATURE ($^{\circ}\text{C}$) AT STATION IV.

● = CALYPSO stations

▲ = Zodiac stations

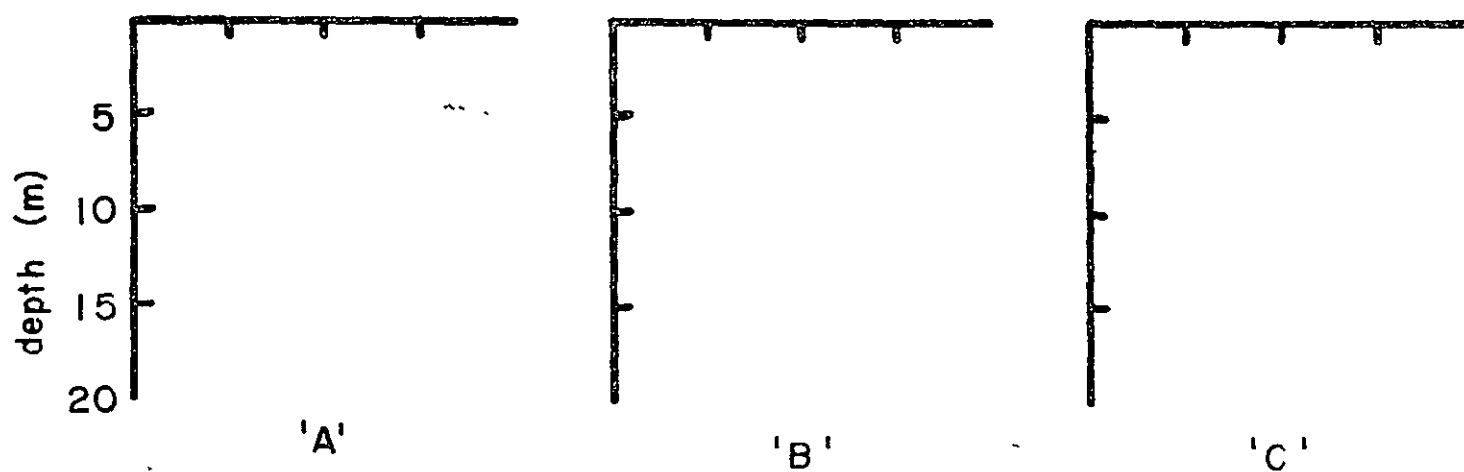
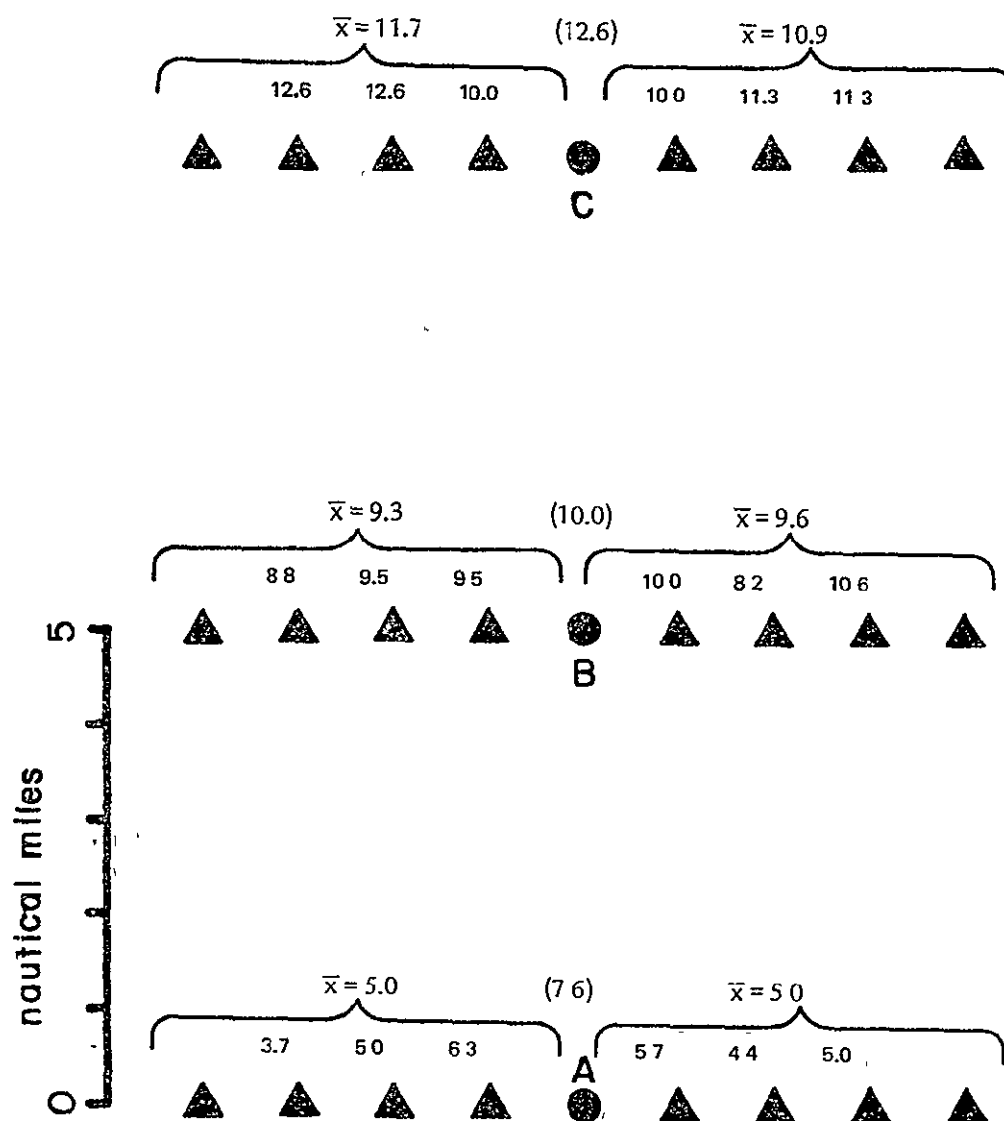
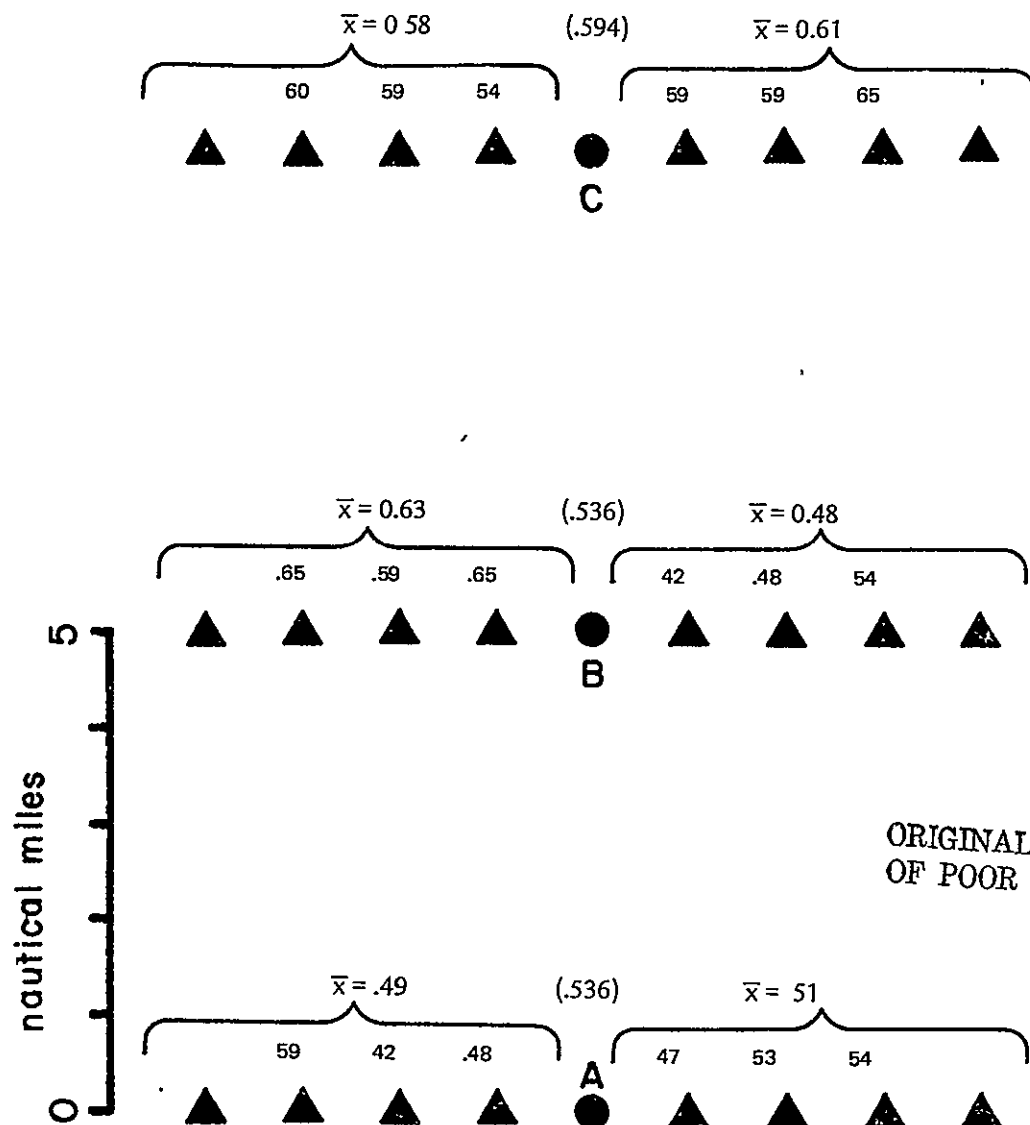


FIG. 5 -c SURFACE AND VERTICAL DISTRIBUTION OF EUPHOTIC ZONE (m) AT STATION IV.

● = CALYPSO stations

▲ = Zodiac stations



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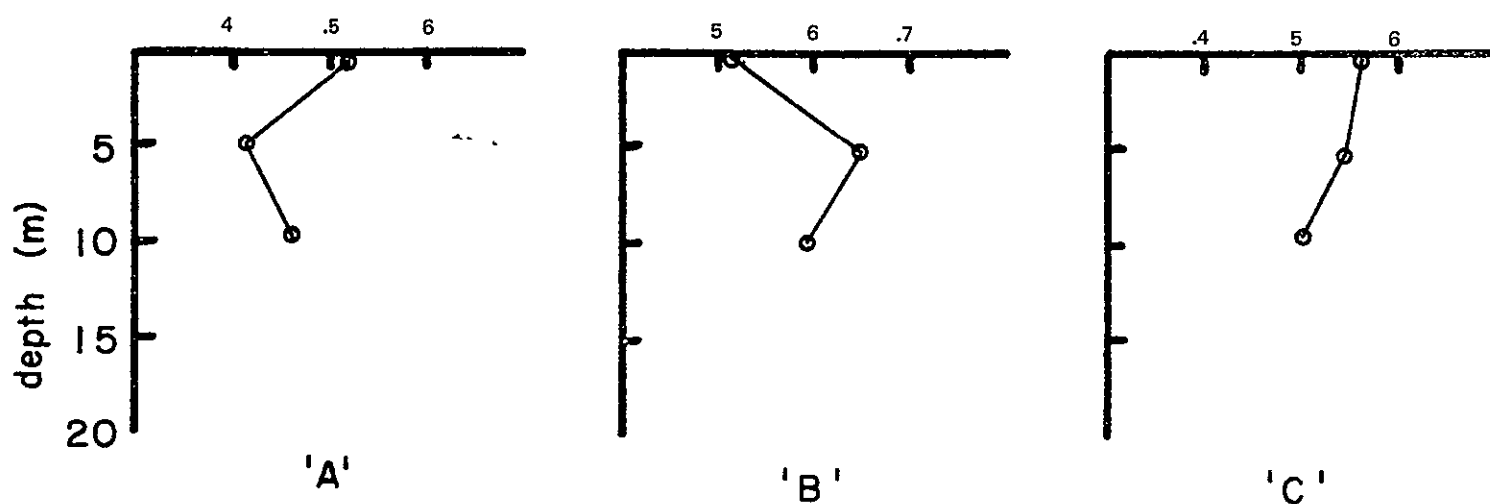


FIG. 5 -d SURFACE AND VERTICAL DISTRIBUTION OF CHLOROPHYLL A (mg/m^3) AT STATION IV.

● = CALYPSO stations

▲ = Zodiac stations

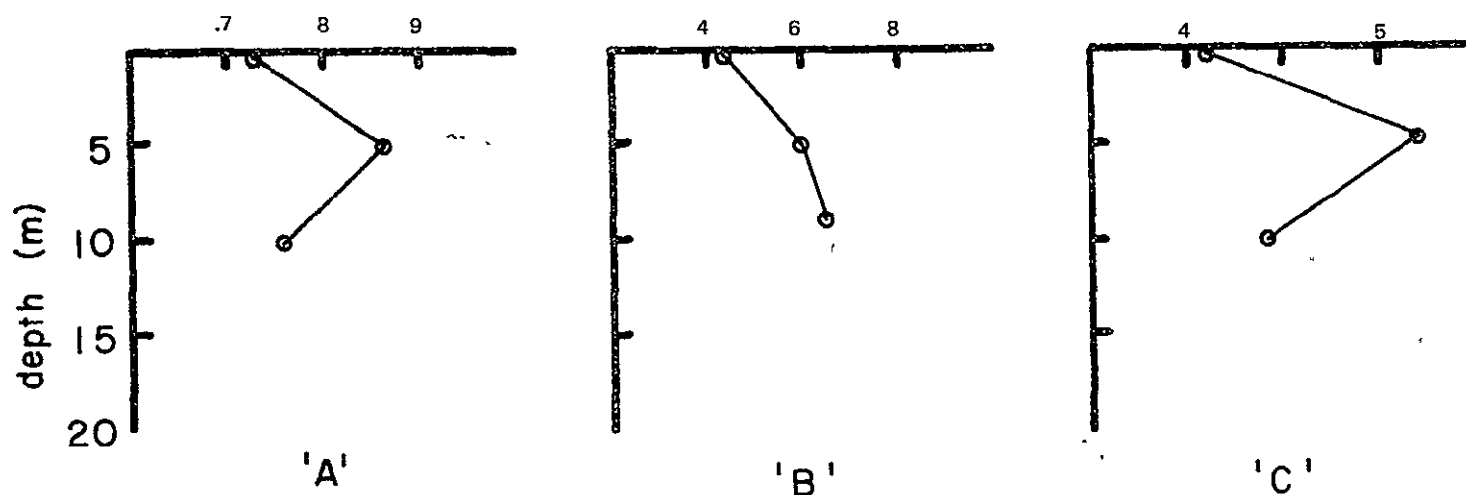
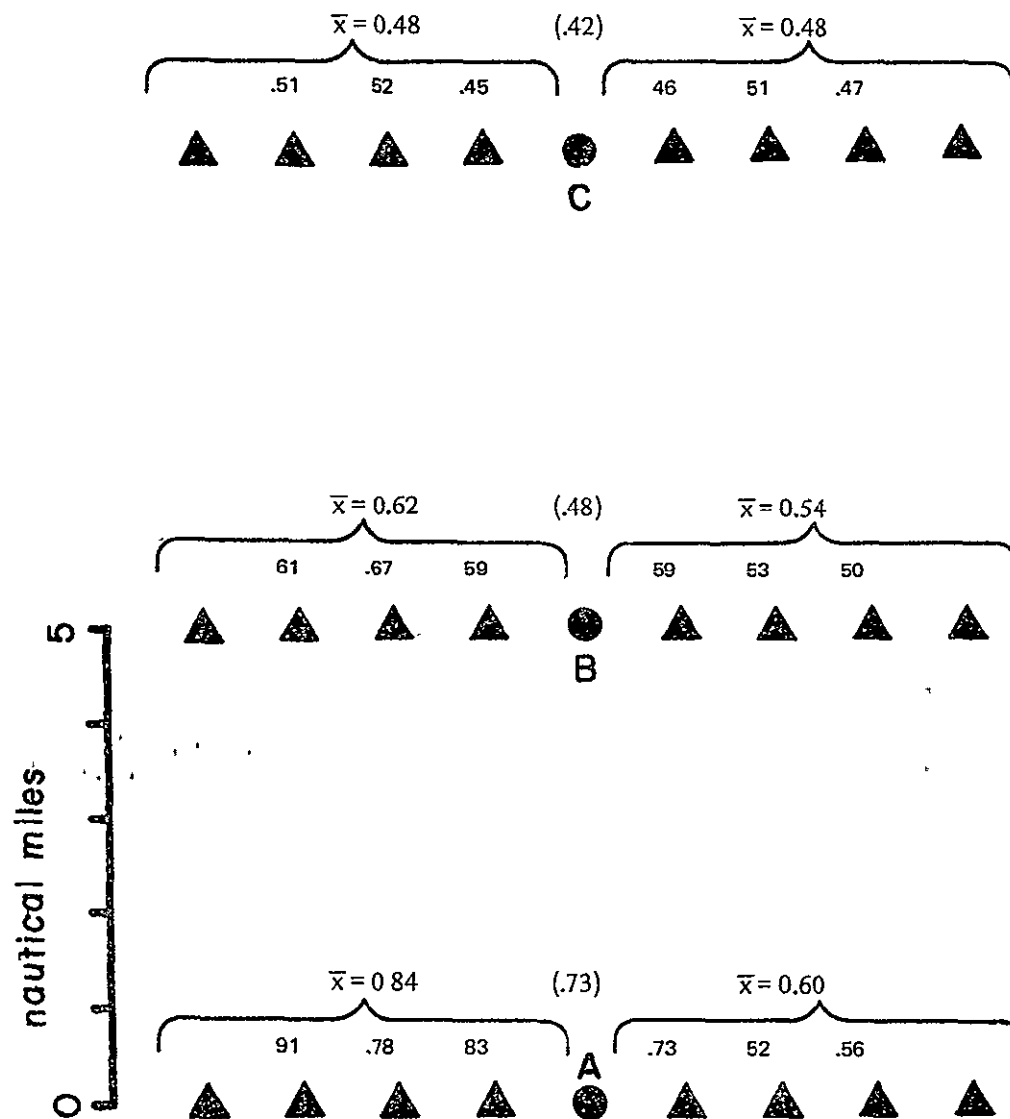


FIG. 5-e SURFACE AND VERTICAL DISTRIBUTION OF PHOSPHATE ($\mu\text{g.at/L}$) AT STATION IV.

● = CALYPSO stations

▲ = Zodiac stations

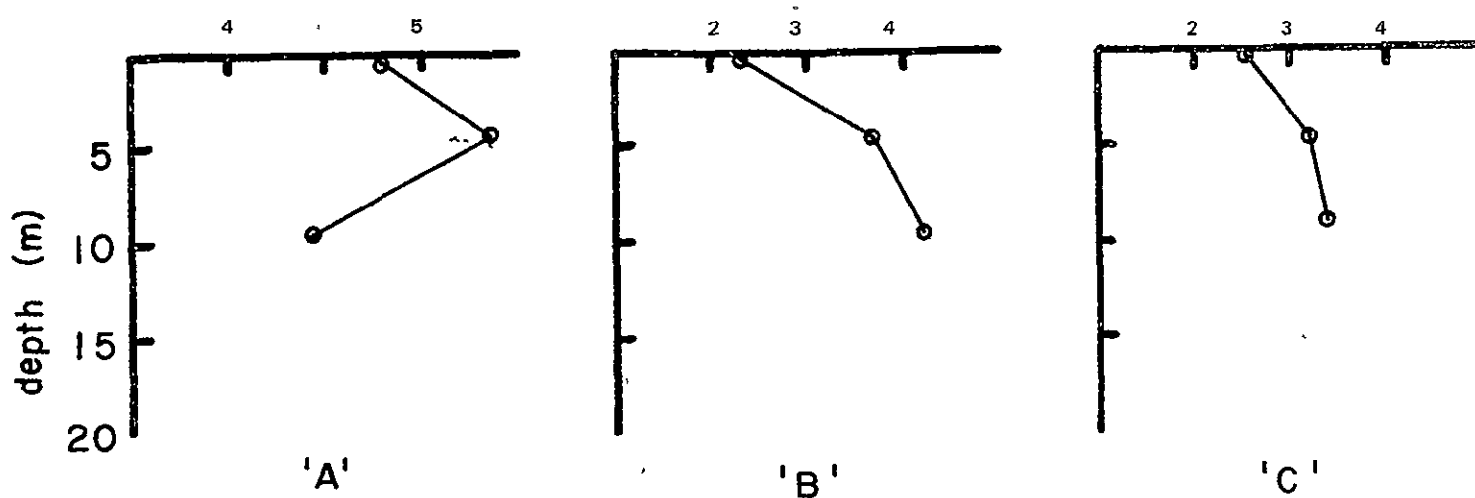
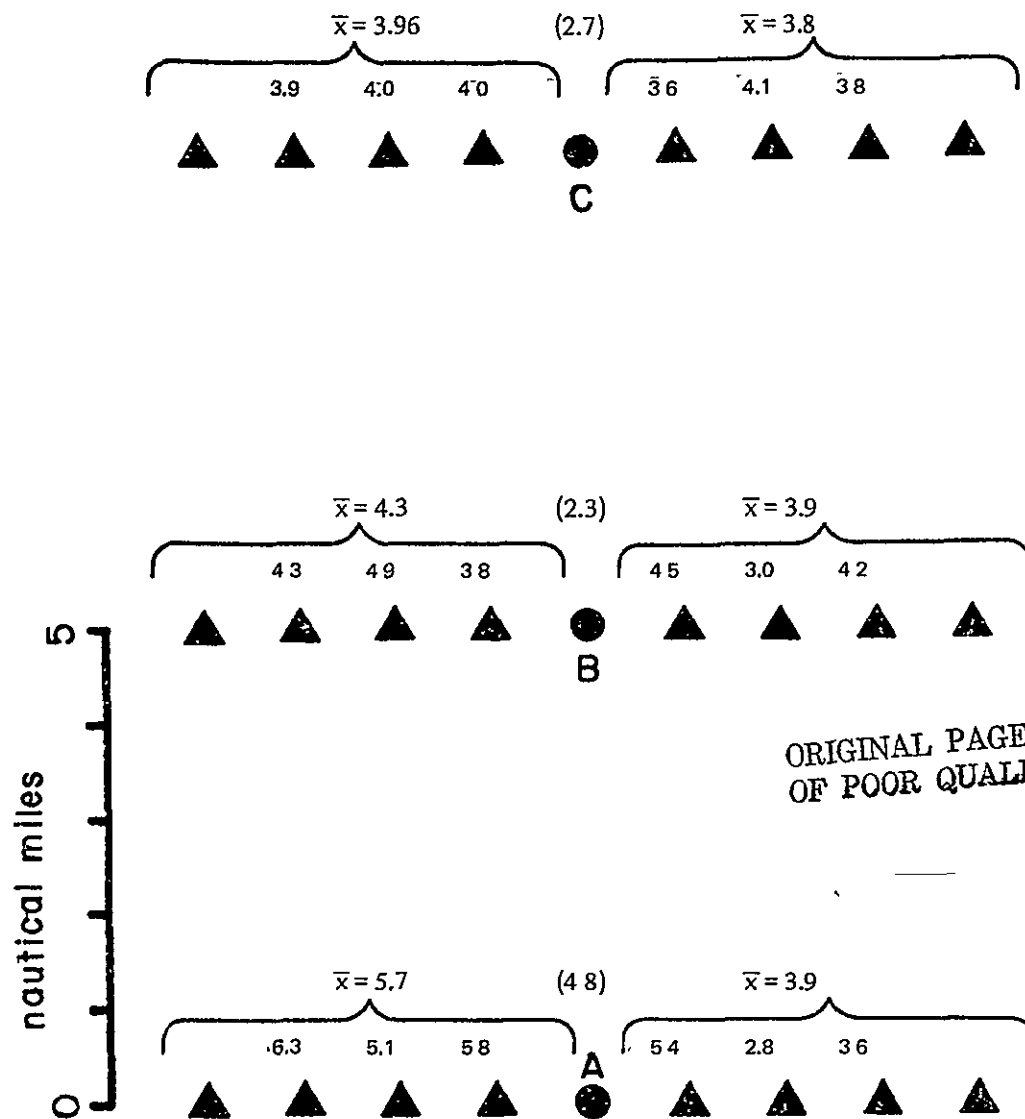


FIG. 5-f SURFACE AND VERTICAL DISTRIBUTION OF SILICATE ($\mu\text{g.at/L}$) AT STATION IV.

● = CALYPSO stations

▲ = Zodiac stations

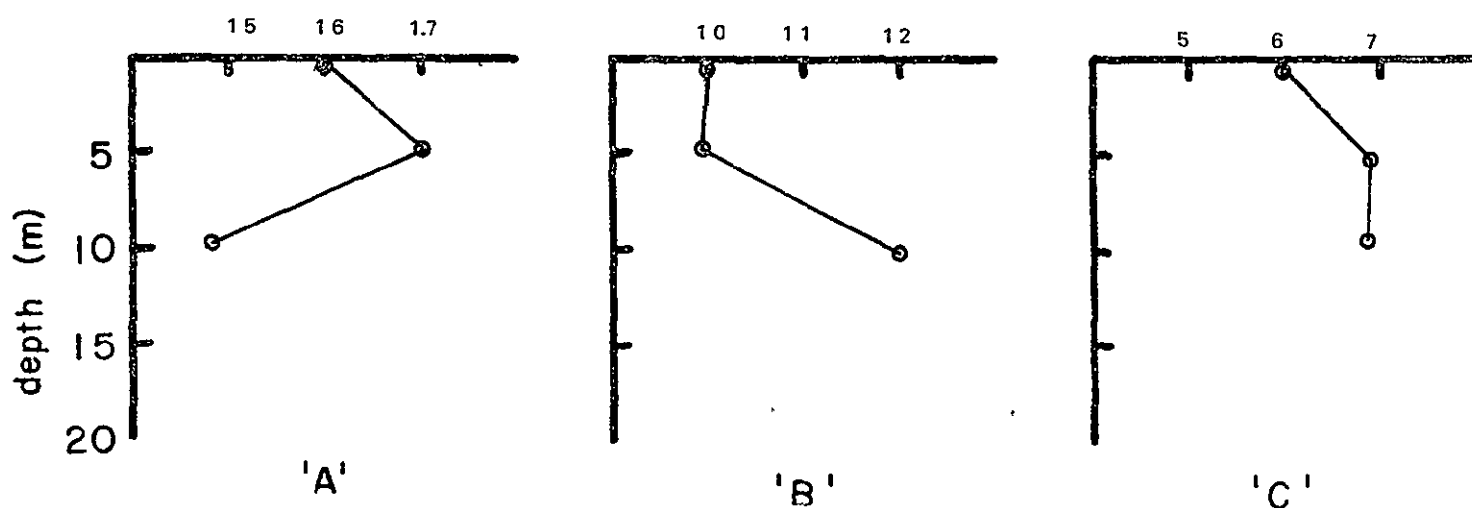
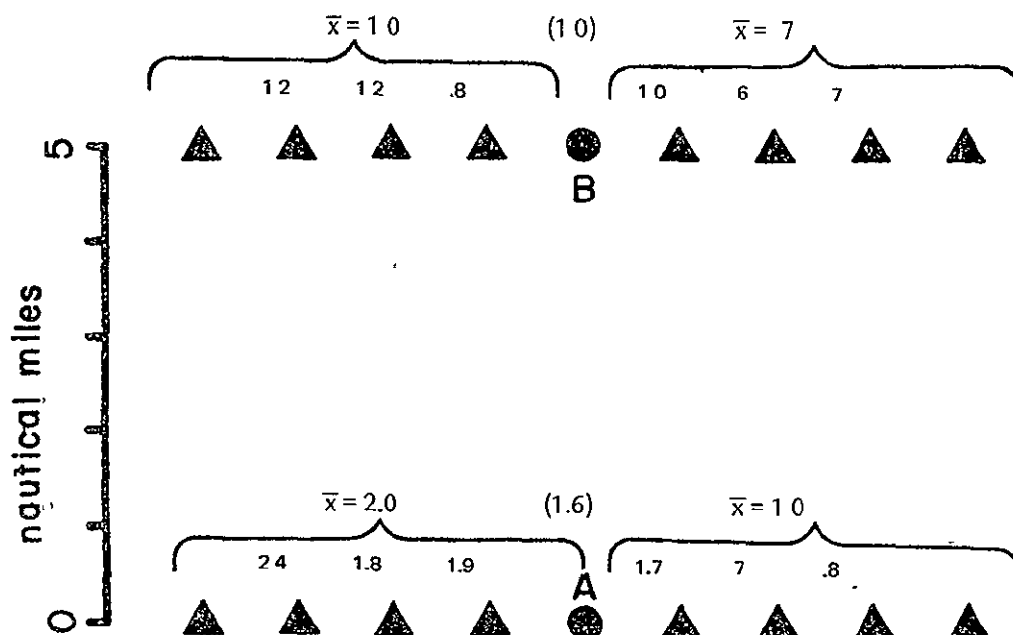
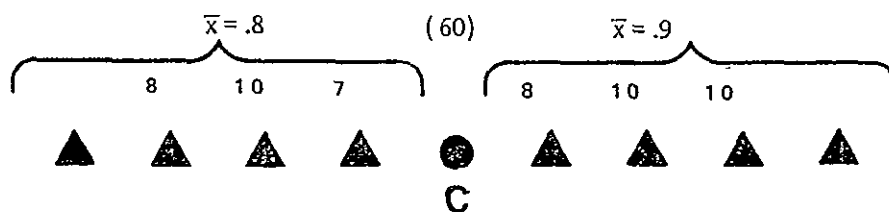


FIG. 5 -g. SURFACE AND VERTICAL DISTRIBUTION OF NITRATE ($\mu\text{g.at/L}$) AT STATION IV.

Station V

This station was occupied on November 17 off the Southwest Pass of the Mississippi Delta. It was selected because of our interest in making observations with regard to the Mississippi plume. The area occupied was characterized by the cold, turbid river water coming in contact with the warm relatively clear sea water lying at the periphery of the plume. Array A was occupied due west of the Southwest Pass, while Array C was located SE of Array A, close to the 100 fathom line.

Salinity (Fig. 6-a)

The salinity distribution clearly shows the effect of the Mississippi River in reducing the salinity in the study area. Salinity values at the positions occupied in Array B gave conspicuously lower values than those of positions A and C. Lowest salinity value (8.82‰) was recorded by the Zodiac(L) in Array B; the highest salinity (33.09‰) was reported from one of the positions of Zodiac(L) in the C Array. Vertical salinity distribution showed gradual increase between surface and 15 m.

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Temperature (Fig. 6-b)

Except for the slightly higher sea-surface temperature reported by Zodiac(L) in Array C, surface temperature did not show great variations in the study area. The vertical temperature distributions shown in the above figure show some increase with depth, in two cases.

Chlorophyll a (Fig. 6-c)

The chlorophyll values reported from the Zodiac(R) stations showed slightly higher values at A and C Arrays than at the CALYPSO stations or the Zodiac(L) positions. At Array B, both the Zodiac positions reported higher values than at the CALYPSO station. At the three CALYPSO stations higher chlorophyll a values were found at all the subsurface depths sampled.

● = CALYPSO stations

▲ = Zodiac stations

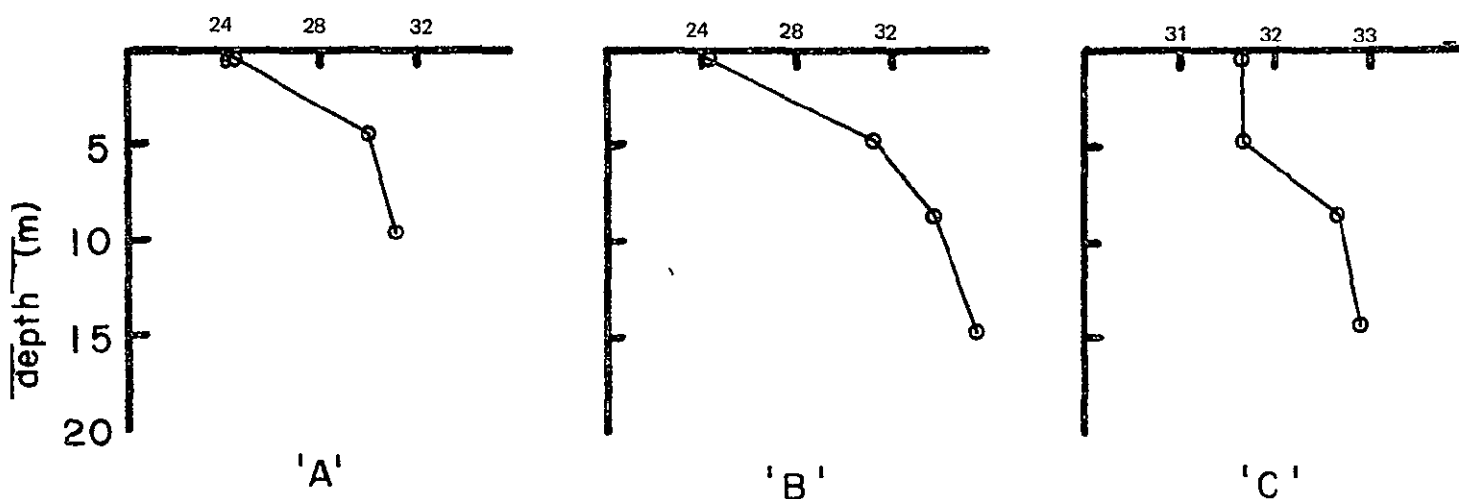
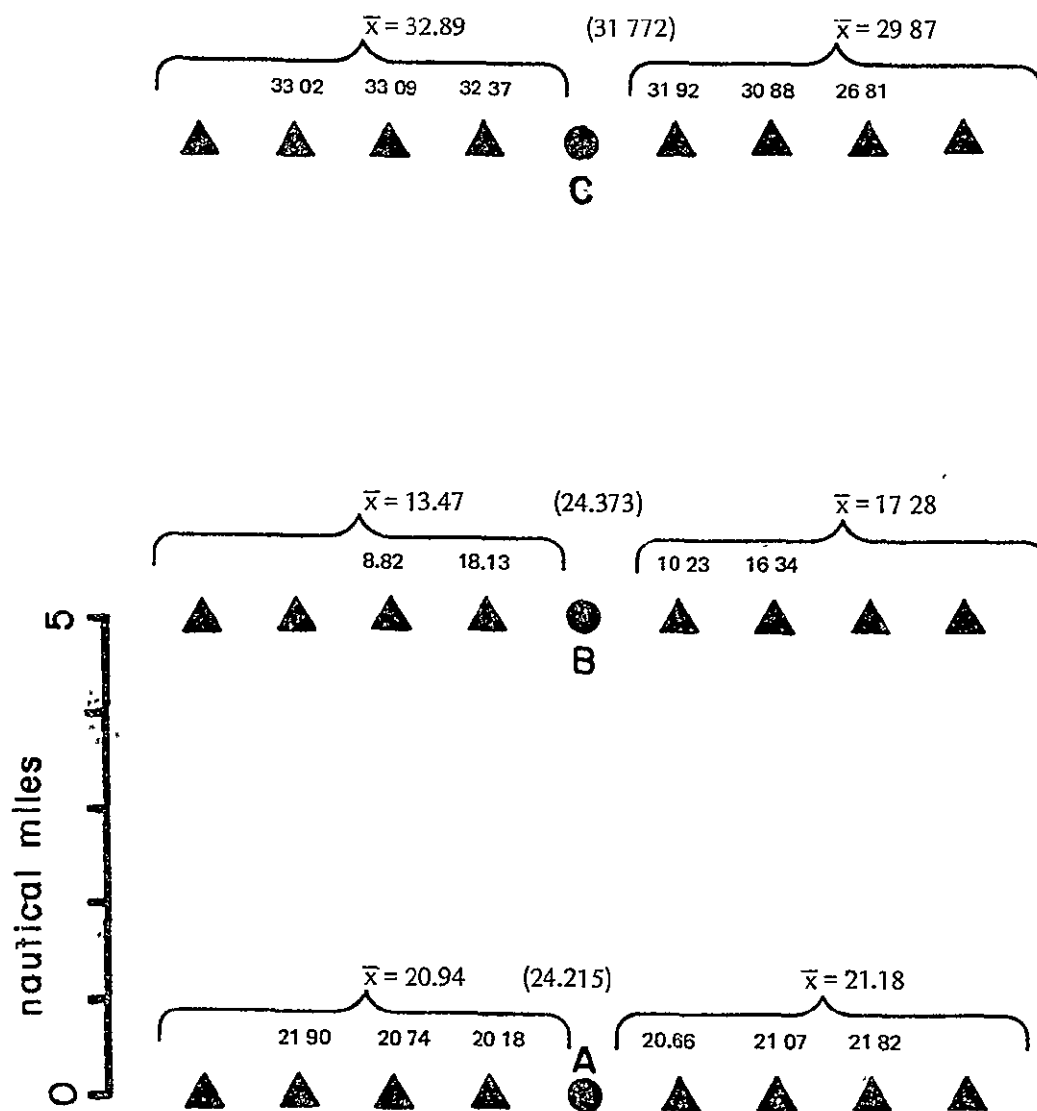


FIG. 6-a SURFACE AND VERTICAL DISTRIBUTION OF SALINITY (‰) AT STATION V.

● = CALYPSO stations

▲ = Zodiac stations

64

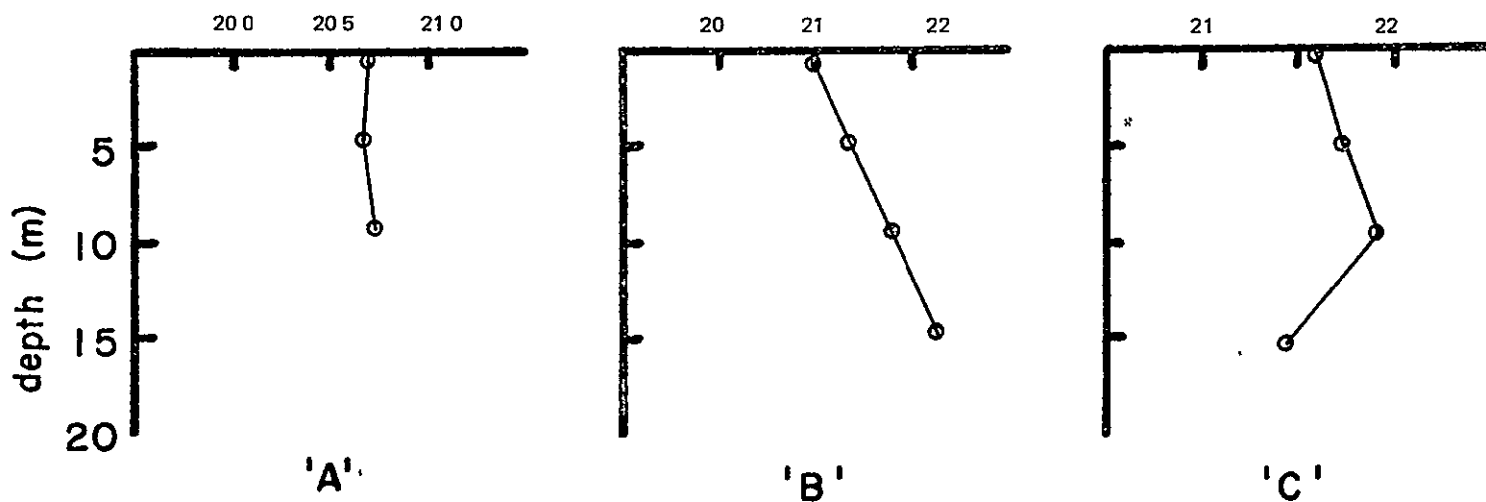
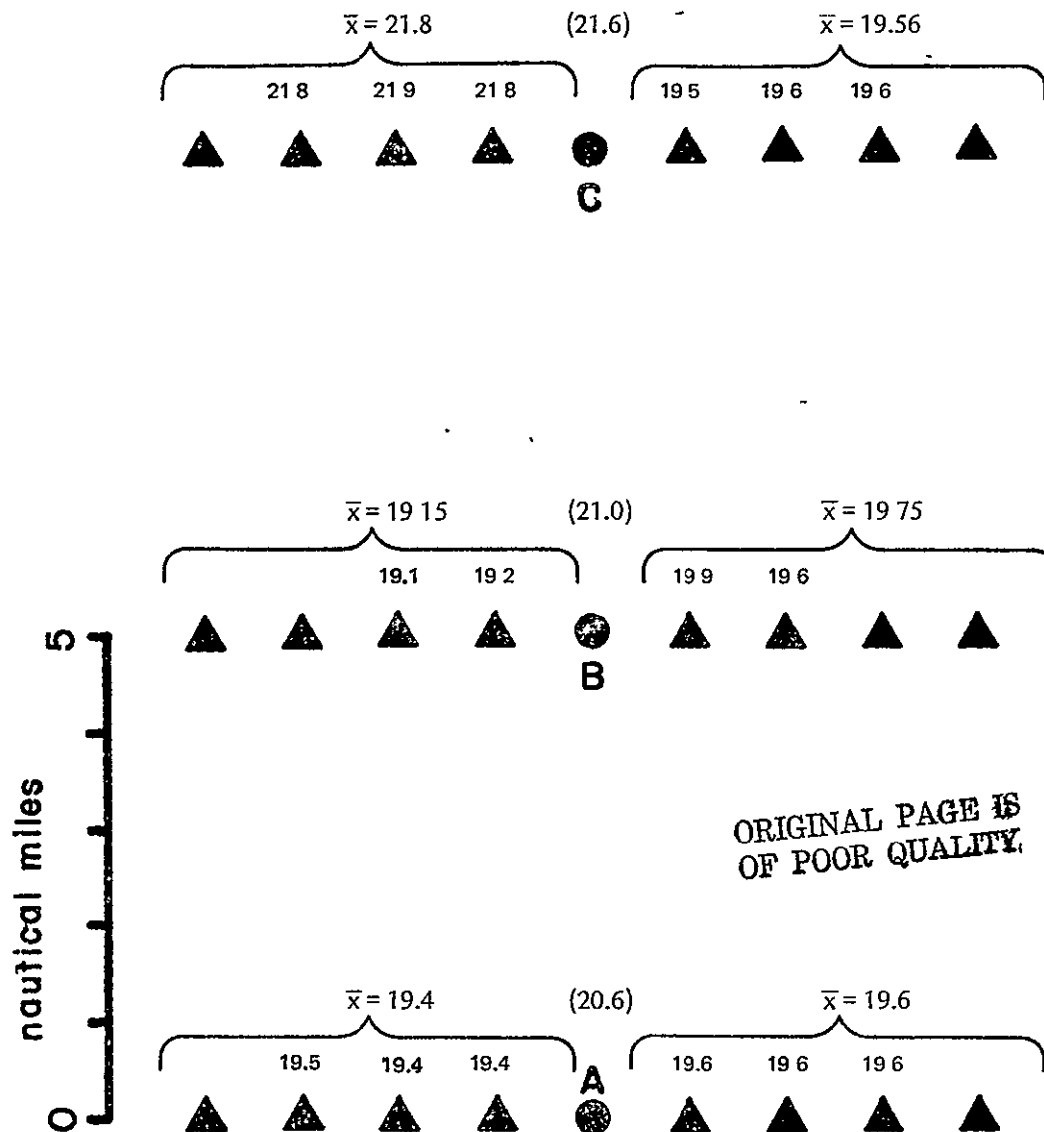


FIG. 6-b SURFACE AND VERTICAL DISTRIBUTION OF TEMPERATURE ($^{\circ}\text{C}$) AT STATION V.

● = CALYPSO stations
 ▲ = Zodiac stations

65

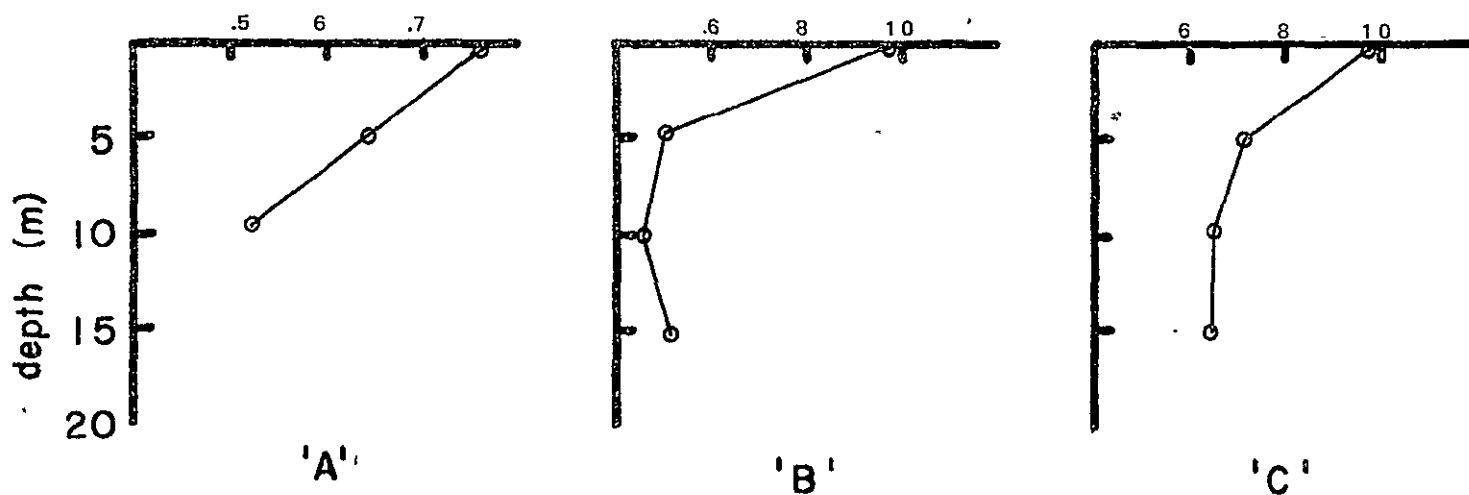
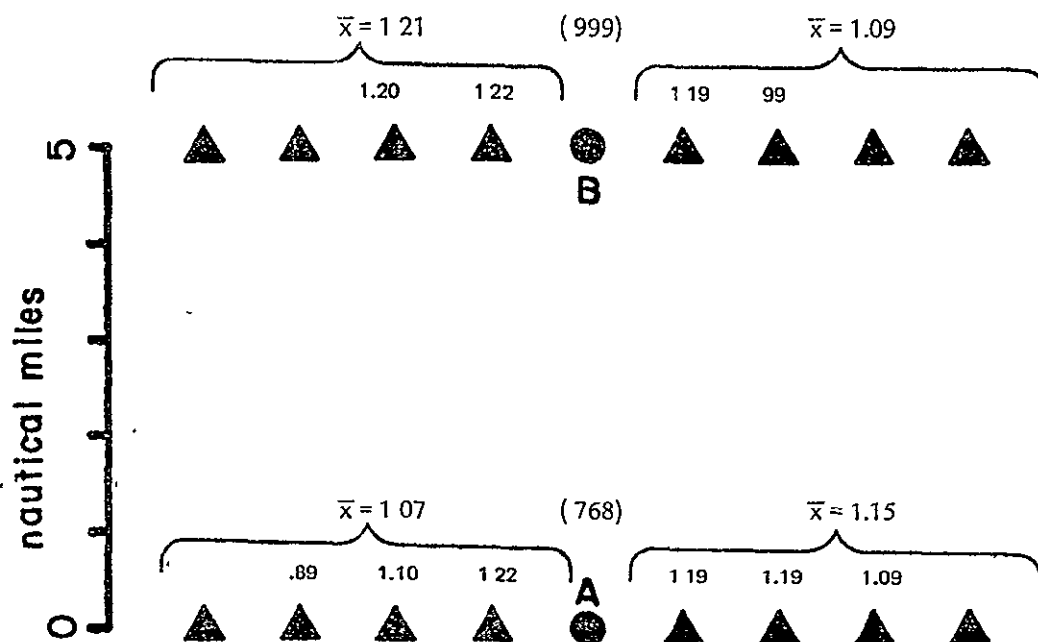
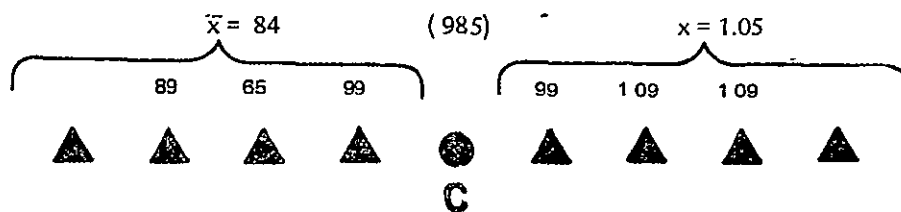


FIG. 6 -c SURFACE AND VERTICAL DISTRIBUTION OF CHLOROPHYLL A (mg/m^3) AT STATION V.

Nutrients (Figs. 6-d, e and f)

Phosphate, silicate and nitrate concentrations in the above figures showed close similarities between Arrays A and B, but were conspicuously different from the values of the offshore positions of Array C. Close similarities were also found in the nutrient concentrations data between the Zodiac and the CALYPSO samples at the positions occupied during Arrays A and B. However, marked variations seem to characterize the samples taken at Array C. The vertical distributions of the three nutrient salts showed gradual decrease with depth.

Station VI

This station was occupied on November 18, 1974, off Mobile Bay, Alabama. It was selected to provide comparison with the other stations which showed significant fresh-water input. Unlike the two preceding stations, Array A was the outermost one; that of C was nearest to the shore. It should also be pointed out that unlike Stations II, III and IV where the three Arrays were spaced by approximately five nautical miles, the spacing between Arrays varied considerably at the subsequent stations occupied.

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Salinity (Fig. 7-a)

The salinity distribution at this station did not show noticeable variations either between the positions occupied in Arrays A, B and C, or between the CALYPSO stations and those of the Zodiacs. Average salinity at Station VI was about 34.2‰. Except for the slight increase of salinity with depth (to 20 m) at CALYPSO Station B, the vertical salinity distribution remained almost the same in the three shallow water columns studied.

Temperature (Fig. 7-b)

The distribution of temperature, like that of salinity, did not vary appreciably either horizontally or vertically.

● = CALYPSO stations

67

▲ = Zodiac stations

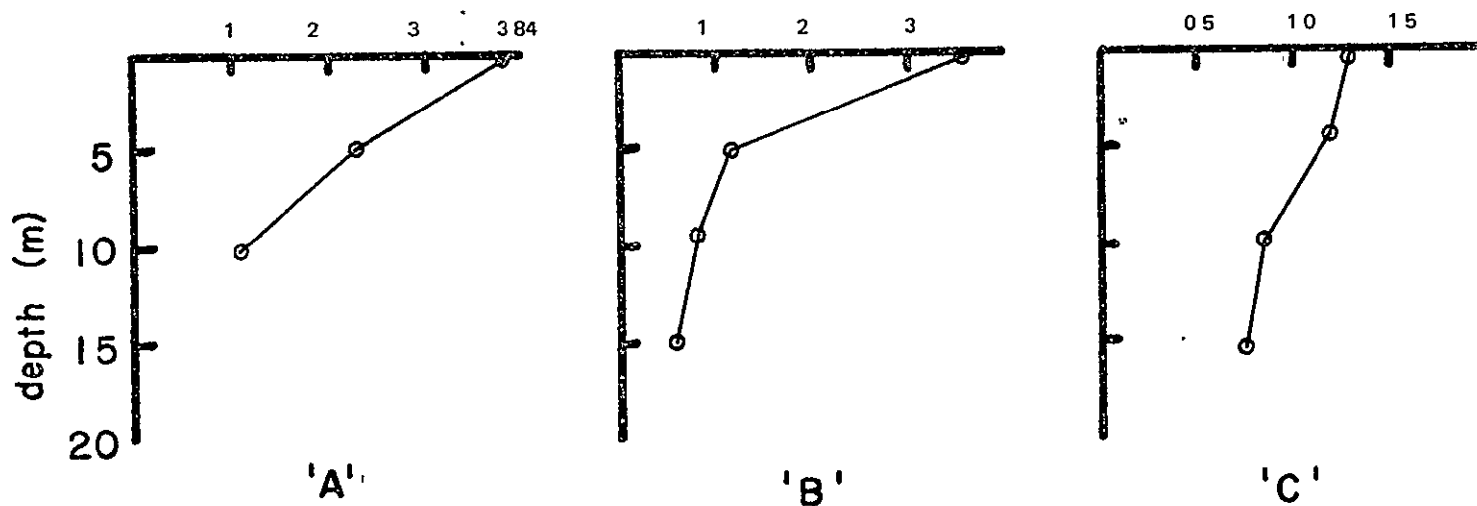
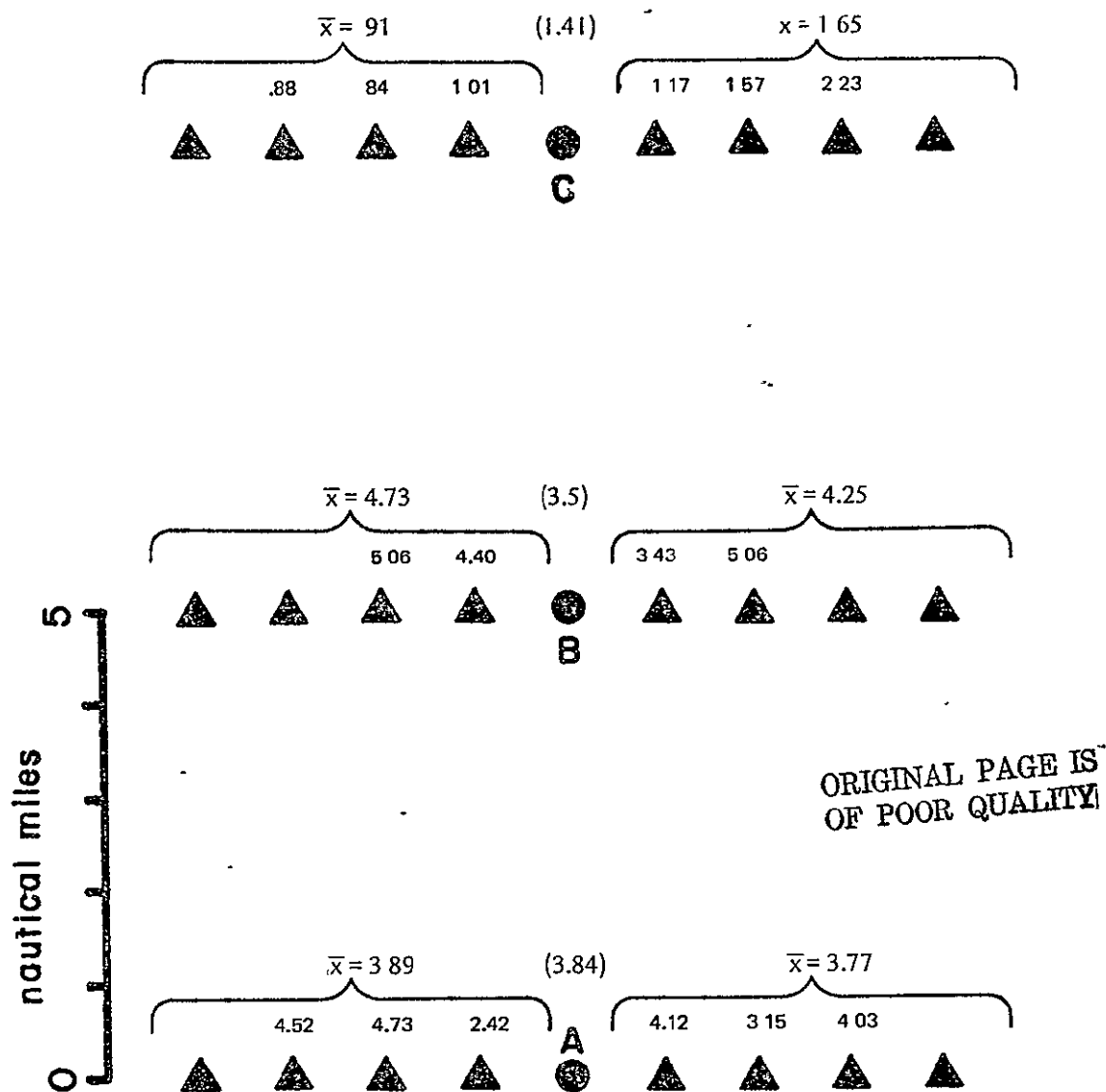


FIG. 6-d SURFACE AND VERTICAL DISTRIBUTION OF PHOSPHATE ($\mu\text{g.at/L}$) AT STATION V.

● = CALYPSO stations

▲ = Zodiac stations

68

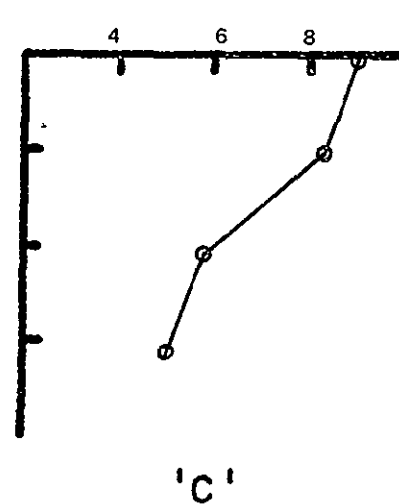
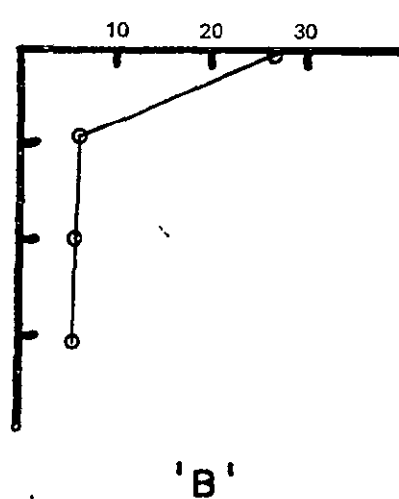
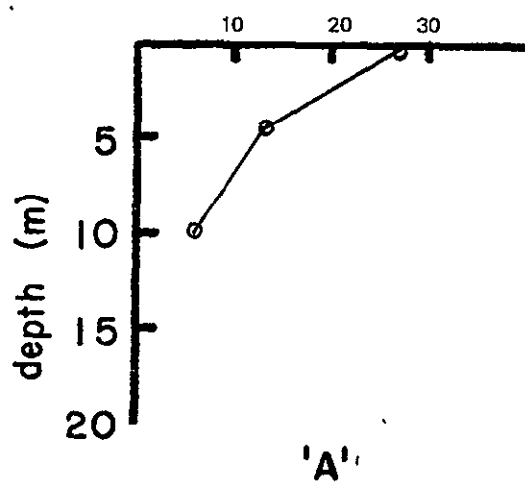
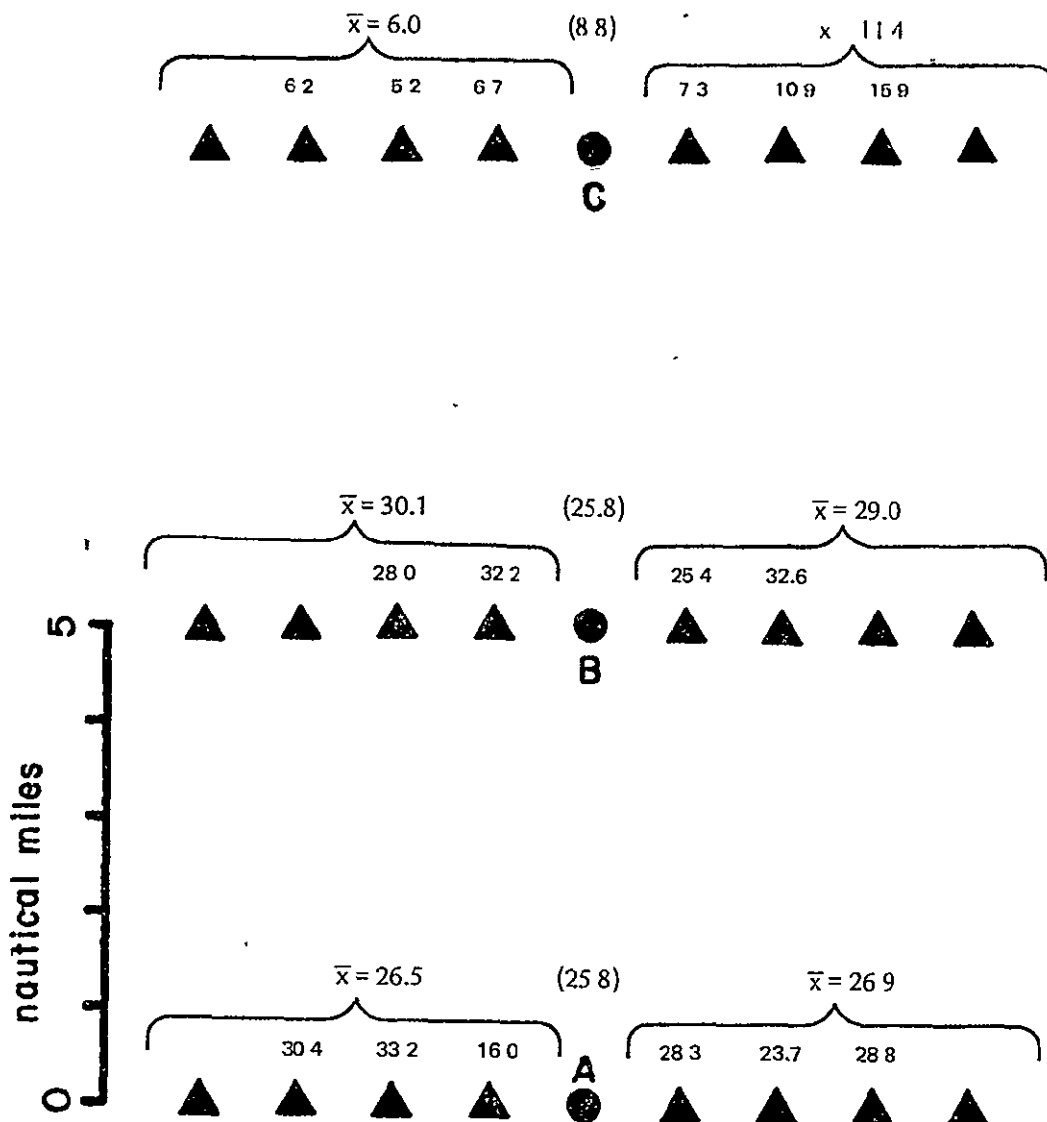


FIG. 6-e SURFACE AND VERTICAL DISTRIBUTION OF SILICATE (μg.at/L) AT STATION V.

● = CALYPSO stations

▲ = Zodiac stations

69

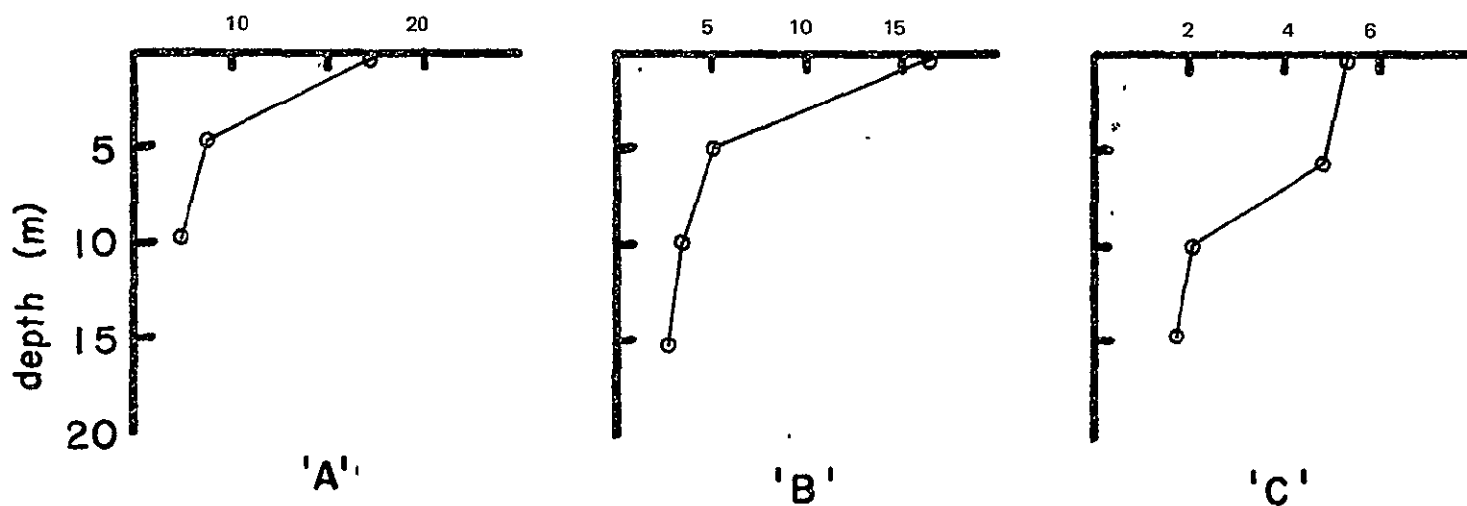
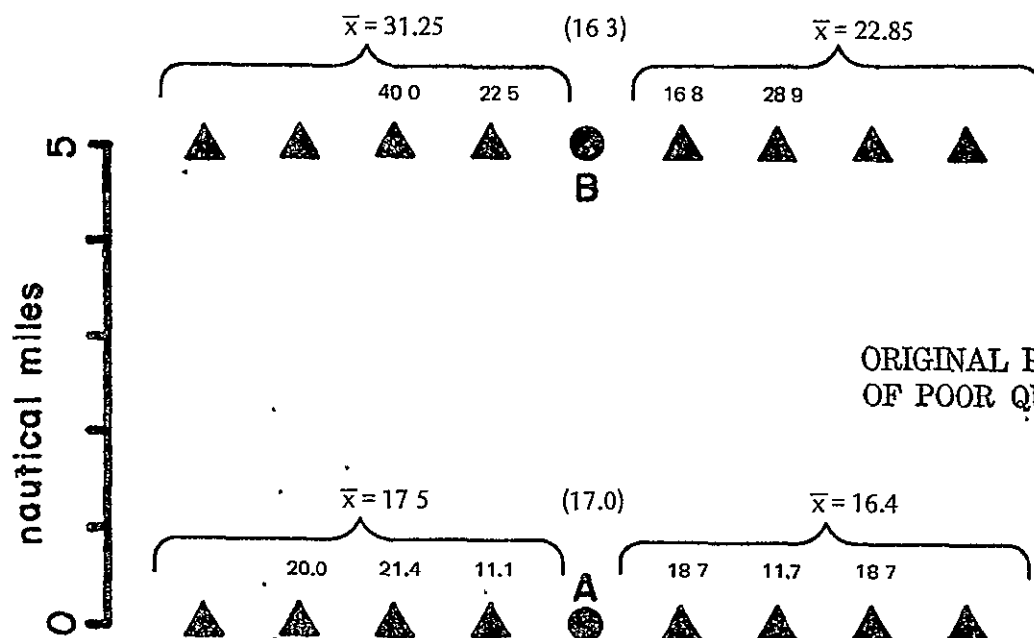
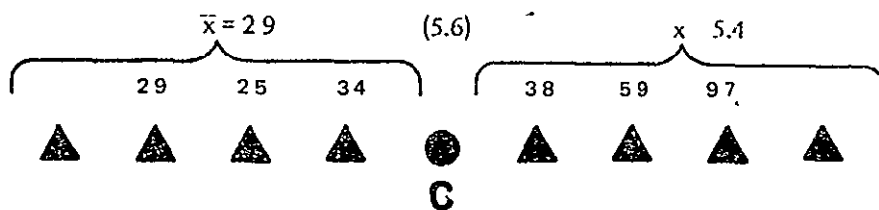


FIG. 6-f SURFACE AND VERTICAL DISTRIBUTION OF NITRATE ($\mu\text{g.at/L}$) AT STATION V.

● = CALYPSO stations

70

▲ = Zodiac stations

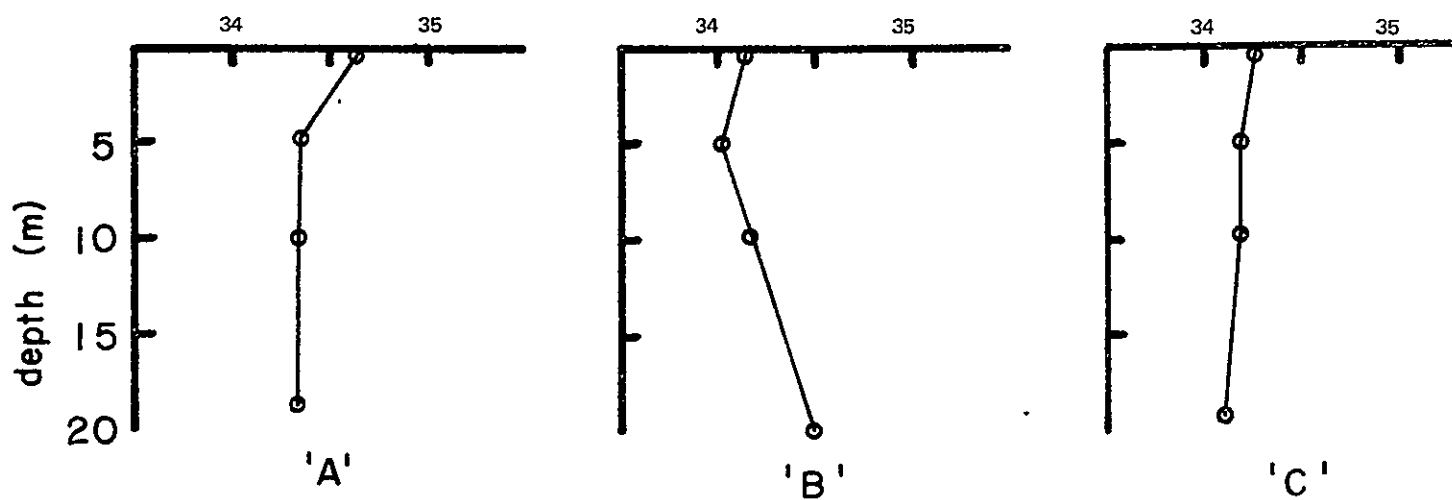
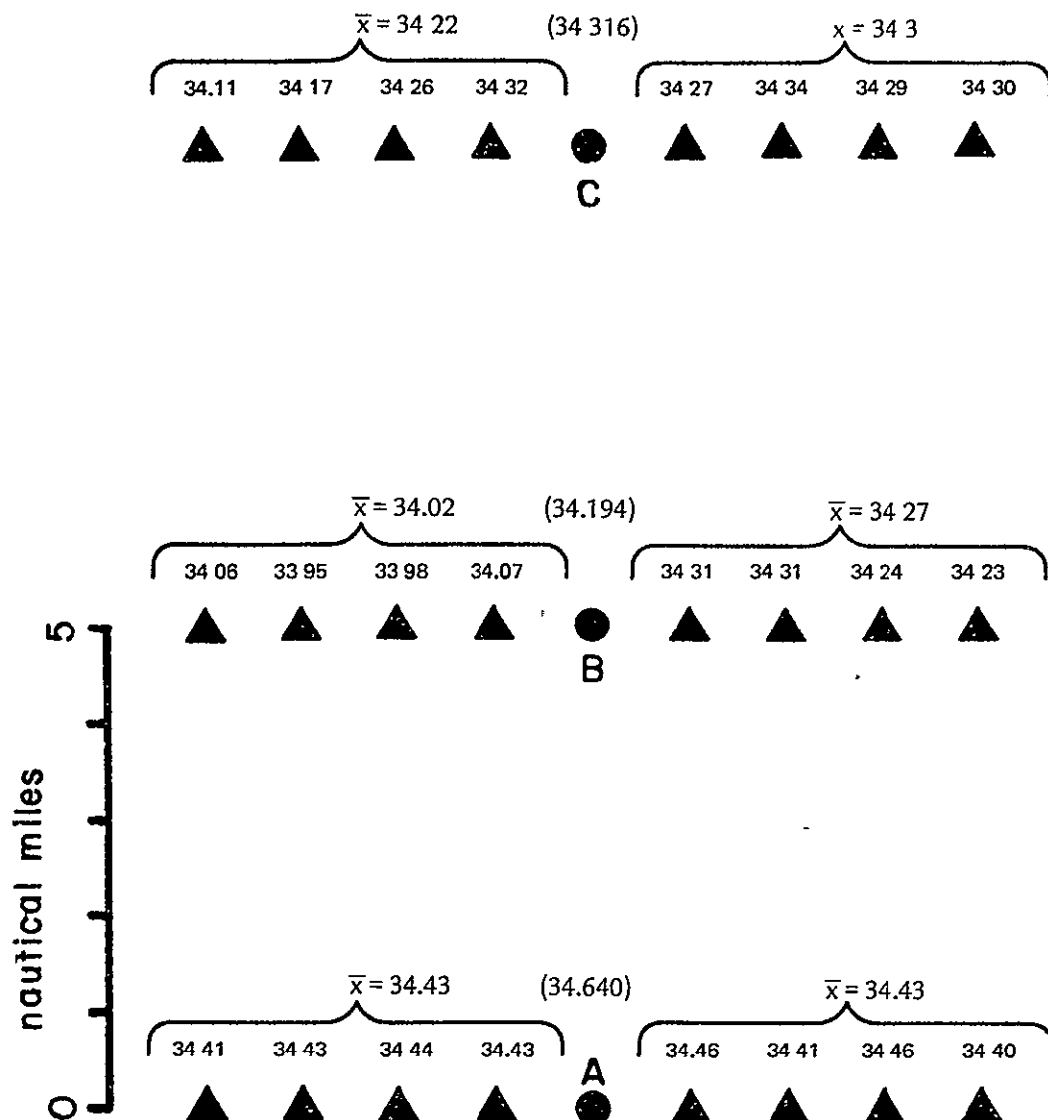


FIG. 7-a SURFACE AND VERTICAL DISTRIBUTION OF SALINITY (‰) AT STATION VI.

● = CALYPSO stations
 ▲ = Zodiac stations

71

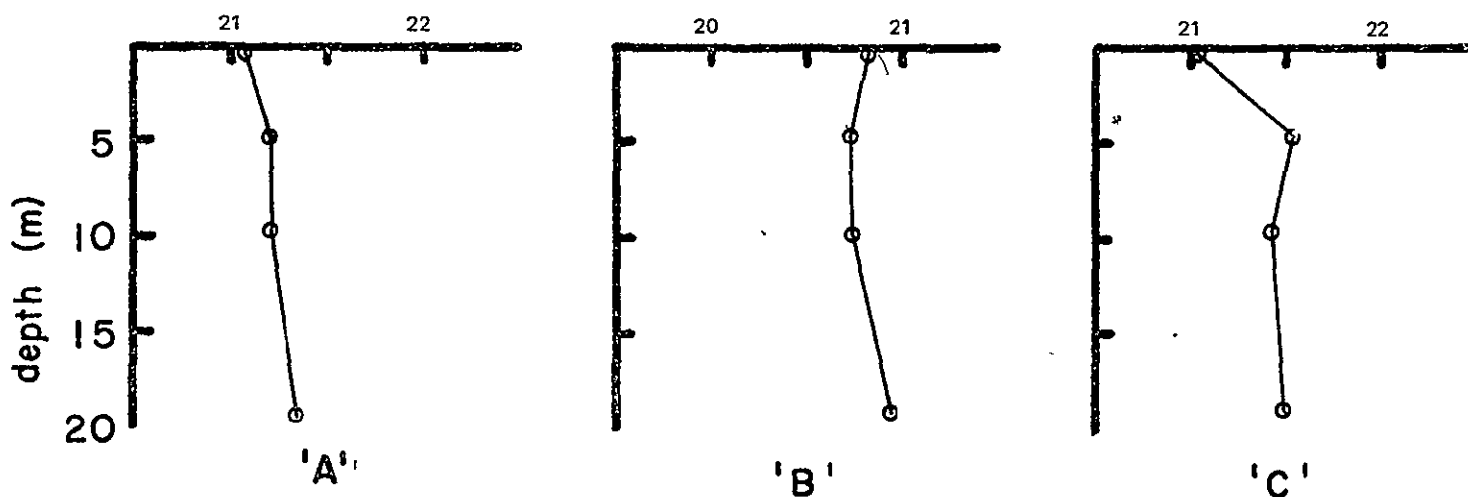
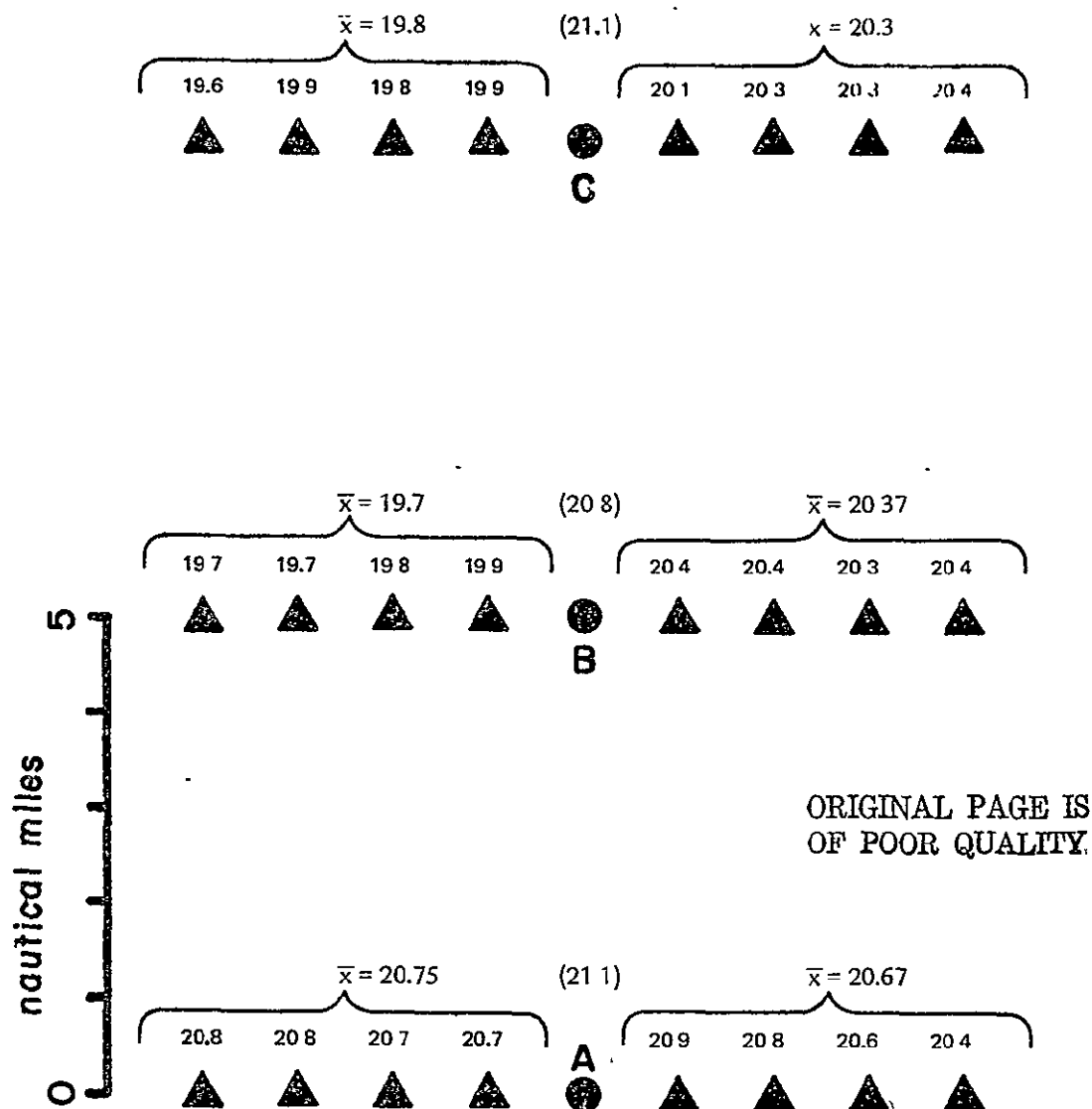


FIG. 7-b SURFACE AND VERTICAL DISTRIBUTION OF TEMPERATURE (°C) AT STATION VI.

Chlorophyll a (Fig. 7-c)

Chlorophyll values, in general, showed no marked variations between the CALYPSO and the Zodiac's samples. The CALYPSO surface chlorophyll a at Array C (near the coast) was about twice as high as those taken in Array A (offshore). With regard to the vertical distribution of chlorophyll at the CALYPSO stations A, B, and C, the above figure shows an increasing trend with depth.

Nutrient Salts (Figs. 7-d, e and f)

Phosphate concentrations showed no conspicuous variations between the CALYPSO stations and those of the Zodiac's positions (Fig. 6-d). Vertical distribution of PO_4 was more erratic at the CALYPSO Station C than at A and B Stations. As to the silicates, no variations between the silicate values reported by the CALYPSO and those of the Zodiacs were reported for Arrays A and B. Array C, while still showing wide variations between the CALYPSO and the Zodiac stations, exhibited less silicate values than at either A or B. The vertical distribution of silicates at the three CALYPSO Stations A, B and C showed an increase in values with depth increase. As to the nitrates, due to the limited data available it was difficult to draw any conclusion regarding their horizontal distribution. In the vertical distribution (Fig. 6-f), we note a decreasing trend with increasing depth between 0 and 10 m.

Station VII

This station was occupied on November 19, 1974, near the head of the DeSoto Canyon. This station is characterized by a relatively steep bottom profile from north to south.

Zodiacs' operations were suspended at this station. However, the CALYPSO occupied three positions where the regular physical, chemical and biological

● = CALYPSO stations

▲ = Zodiac stations

73

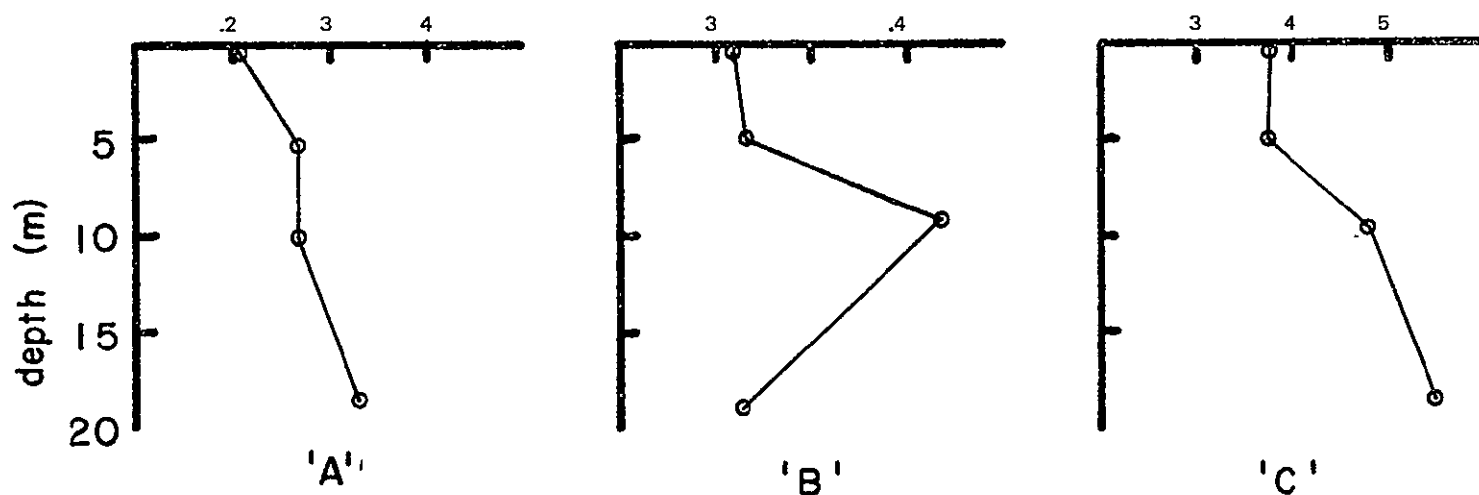
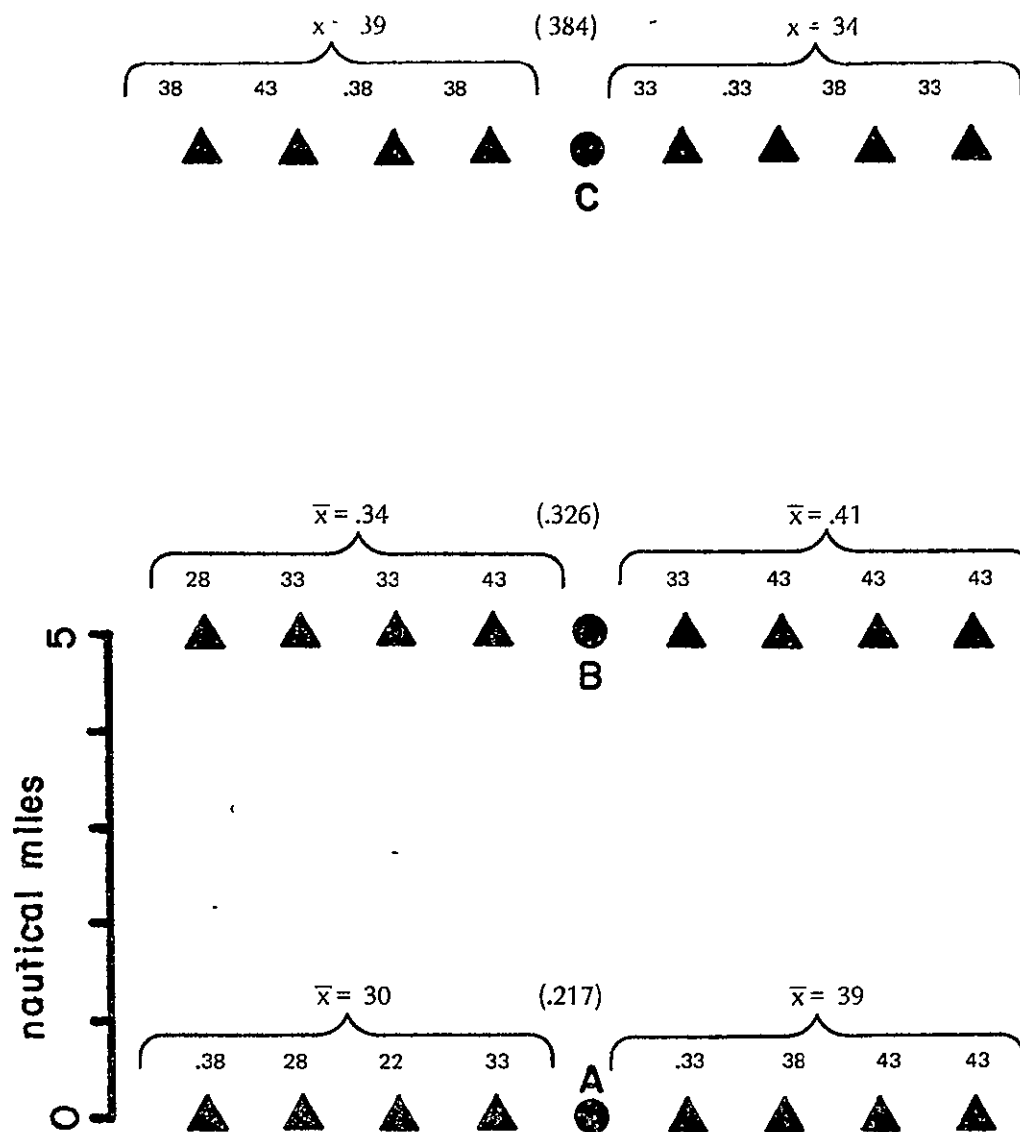


FIG. 7-c SURFACE AND VERTICAL DISTRIBUTION OF CHLOROPHYLL A (mg/m^3) AT STATION VI.

● = CALYPSO stations

▲ = Zodiac stations

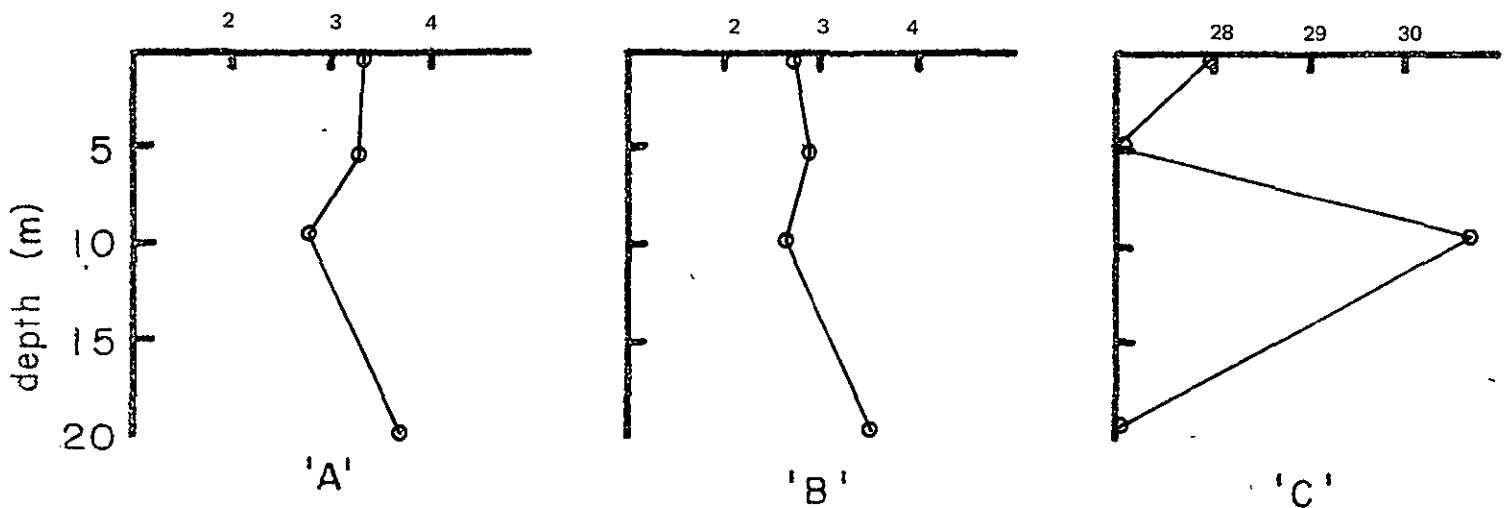
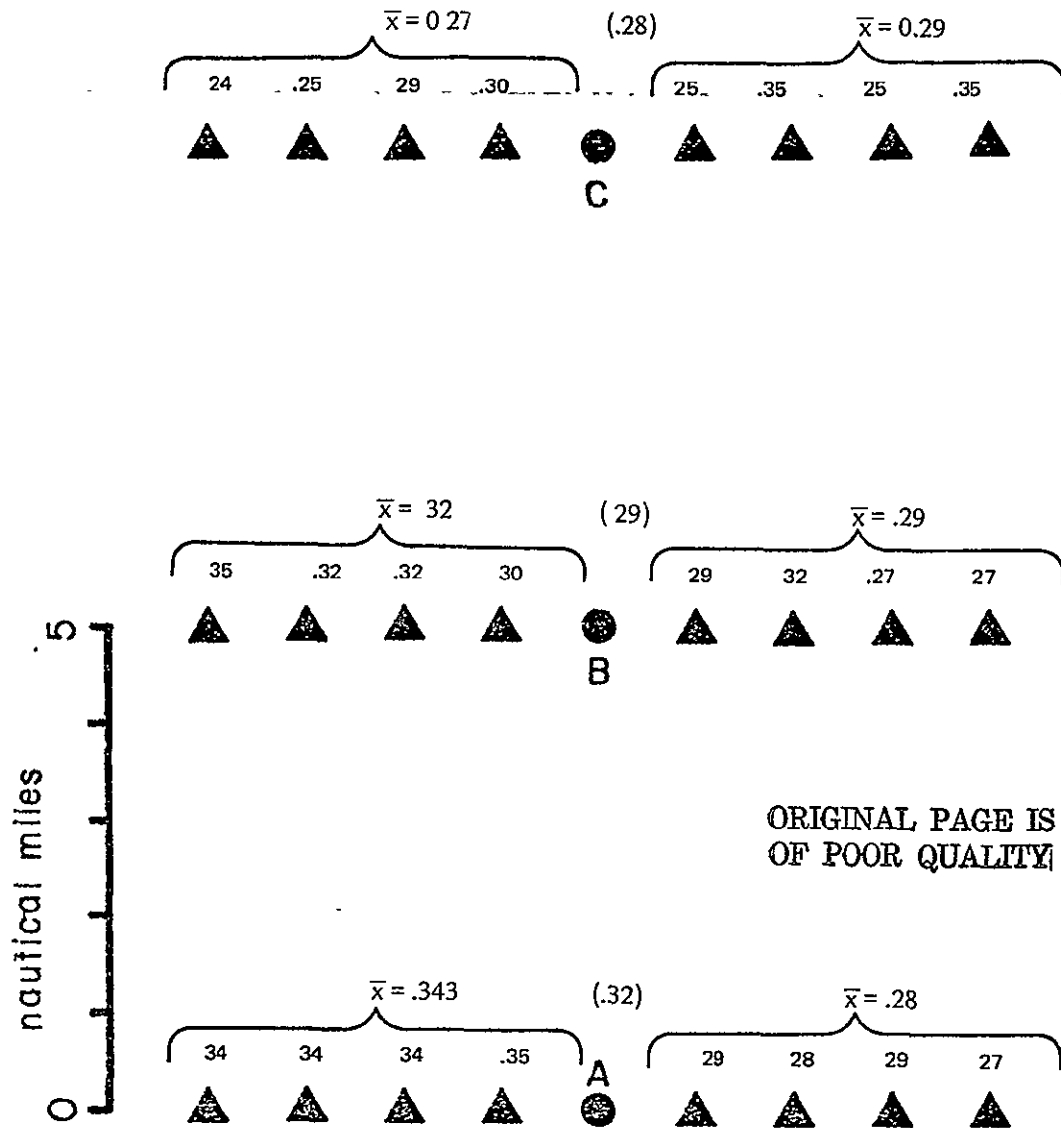


FIG. 7-d SURFACE AND VERTICAL DISTRIBUTION OF PHOSPHATE ($\mu\text{g.at/L}$) AT STATION VI.

● = CALYPSO stations

▲ = Zodiac stations

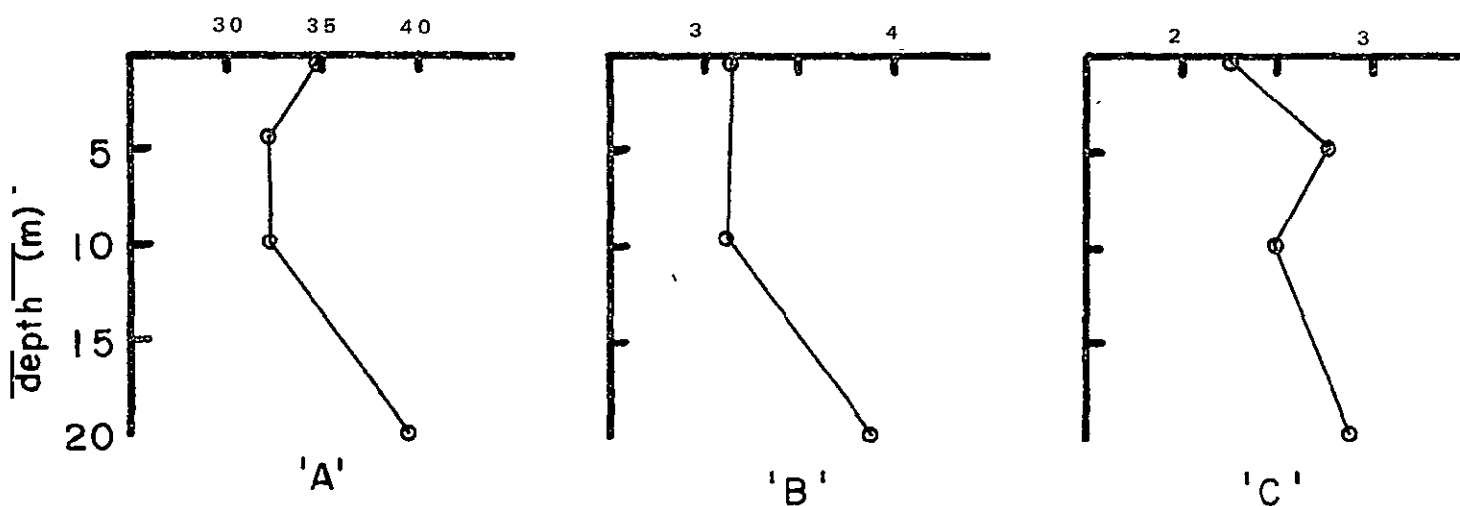
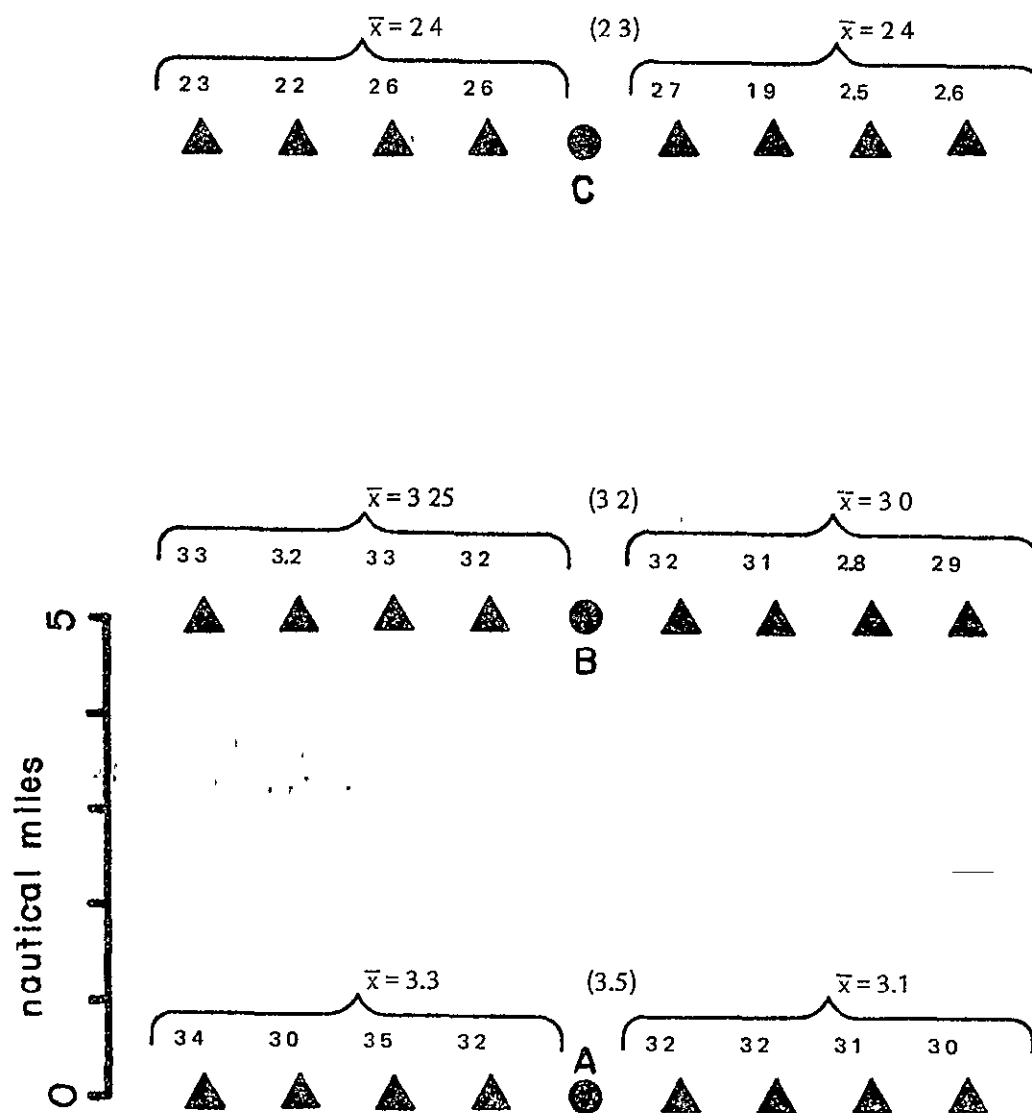


FIG. 7-e SURFACE AND VERTICAL DISTRIBUTION OF SILICATE ($\mu\text{g.at/L}$) AT STATION VI.

● = CALYPSO stations

▲ = Zodiac stations

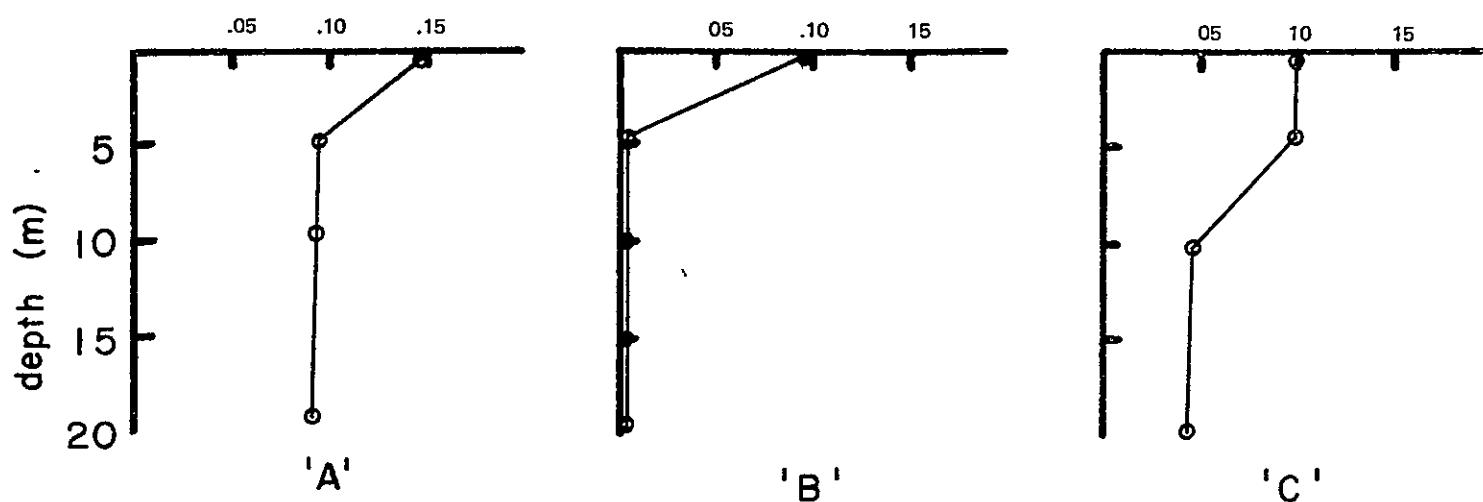
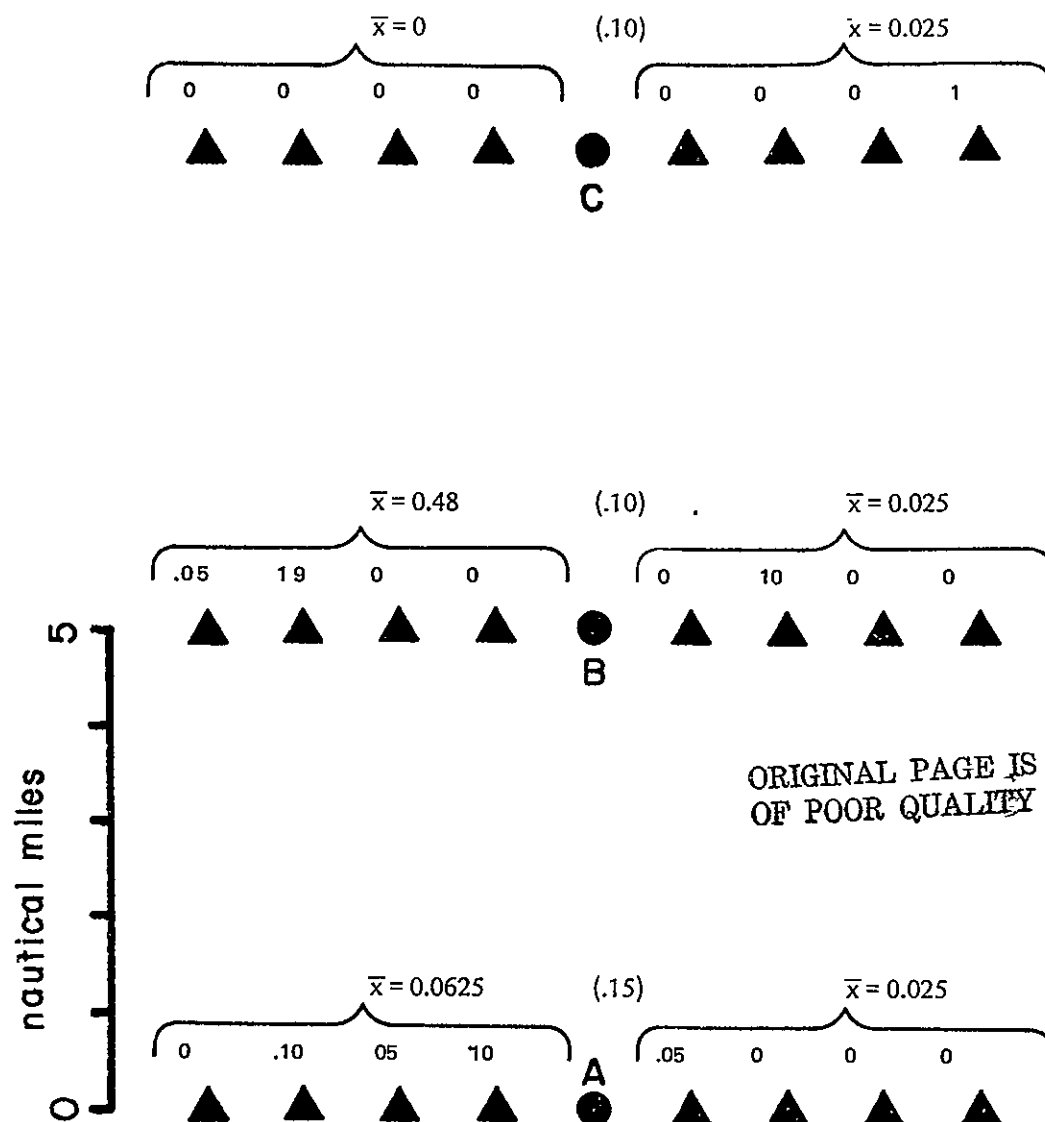


FIG. 7-f SURFACE AND VERTICAL DISTRIBUTION OF NITRATE ($\mu\text{g.at/L}$) AT STATION VI

observations were made. Station A was nearest to the coast, Station C was farthest from the shore.

The vertical distribution of temperature, salinity, chlorophyll a, and phosphates are shown in Figure 8. Also shown in this figure are the depths of the euphotic zones (shown by arrows) at the stations occupied. It is clear from this figure that the depth of the euphotic zone did not vary appreciably between A and B (50.4 and 45.0 m, respectively). However, at the more offshore Station C, the euphotic zone was much deeper, 76.0 m.

Vertical distribution of temperature and salinity showed very little variations with depth. However, a noticeable decrease in temperature was noted between 75 and 100 m at Station C.

Phosphate values also showed very little variations with depth; an increase in phosphate concentration between 75 and 100, however, is quite noticeable at C.

Chlorophyll a showed slight increases in values with depth (between 0 and 10 m), but remained almost constant below 10 m. It is interesting to note from the above figure that significant chlorophyll quantities were still found below the euphotic zone.

Station VIII

This station was occupied on November 20, 1974, just south of Pensacola, Florida. Only surface samples were collected at A, B and C Stations. The former station was the nearest to the coast while C was the farthest from the shore.

Surface salinity (Fig. 9-a) and temperature (Fig. 9-b) showed no discernible variations between the observations made by CALYPSO and the Zodiacs. Chlorophyll a values (Fig. 9-c), phosphate (Fig. 9-d) and silicate (Fig. 9-e) concentrations

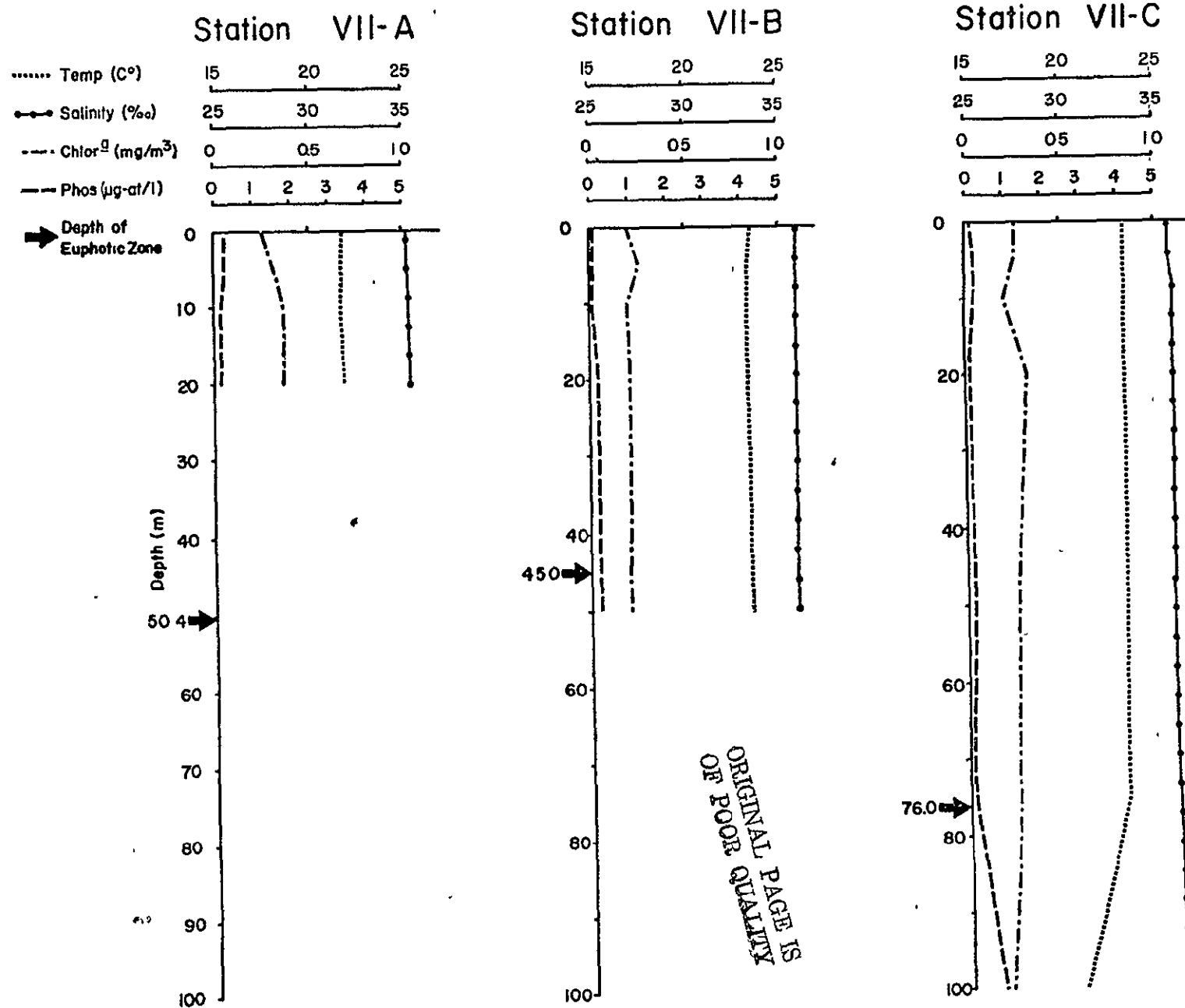


FIG. 8. VERTICAL DISTRIBUTIONS OF TEMPERATURE, SALINITY, CHLOROPHYLL A AND PHOSPHATES AT STATION 7 OCCUPIED DURING LEG I OF R/V CALYPSO CRUISE

● = CALYPSO stations
 ▲ = Zodiac stations

79

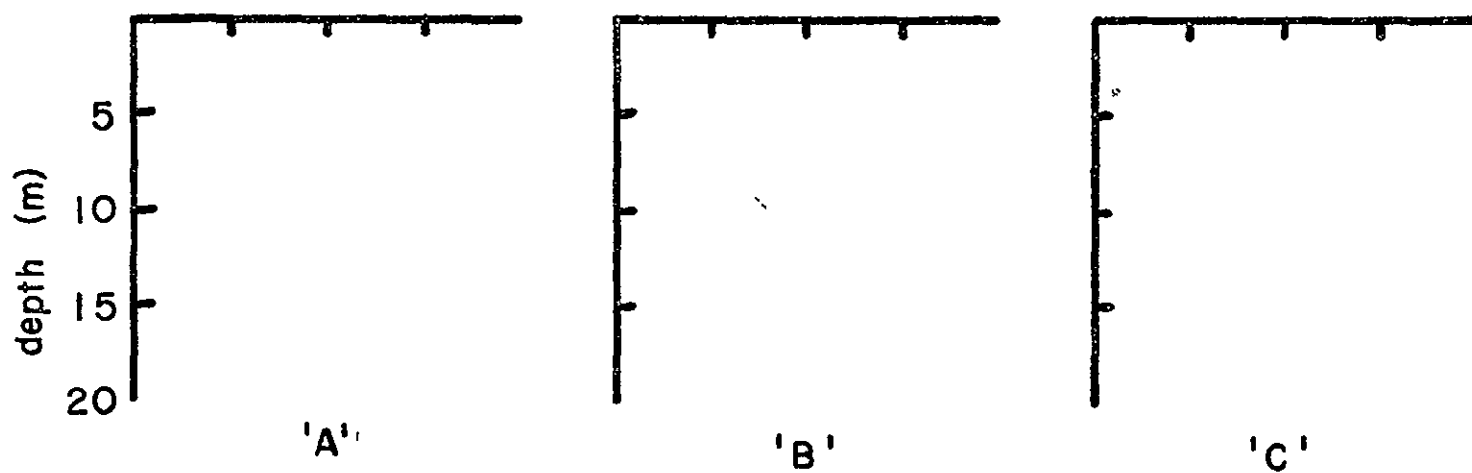
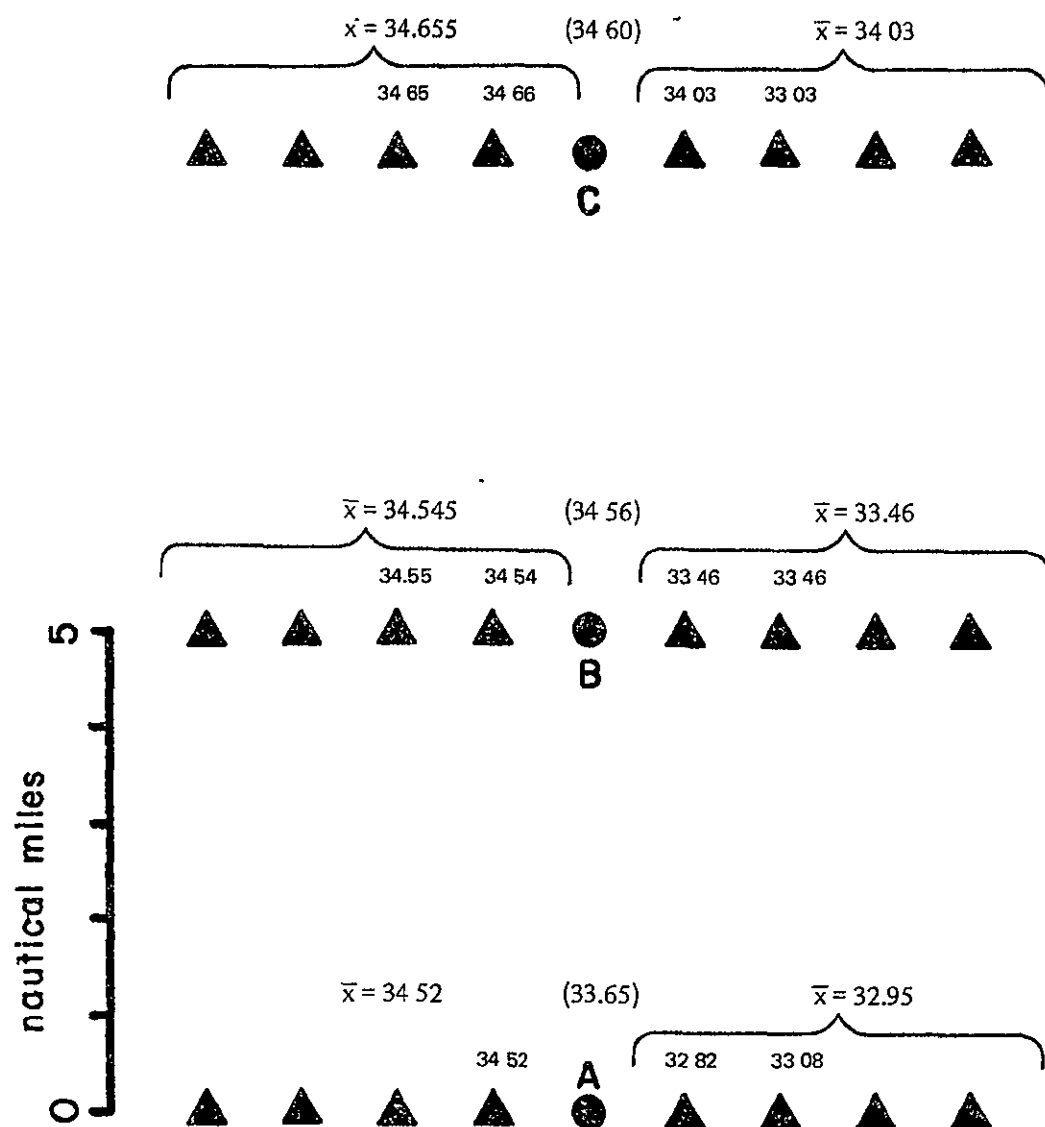


FIG. 9-a SURFACE AND VERTICAL DISTRIBUTION OF SALINITY ($^{\circ}/_{\infty}$) AT STATION VIII.

● = CALYPSO stations
 ▲ = Zodiac stations

80

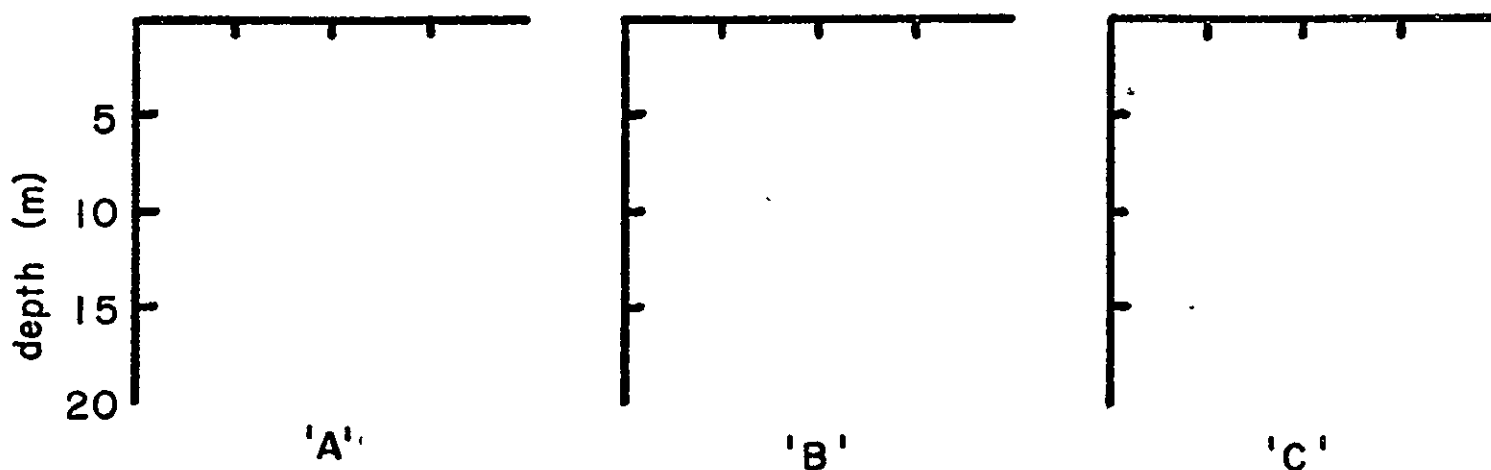
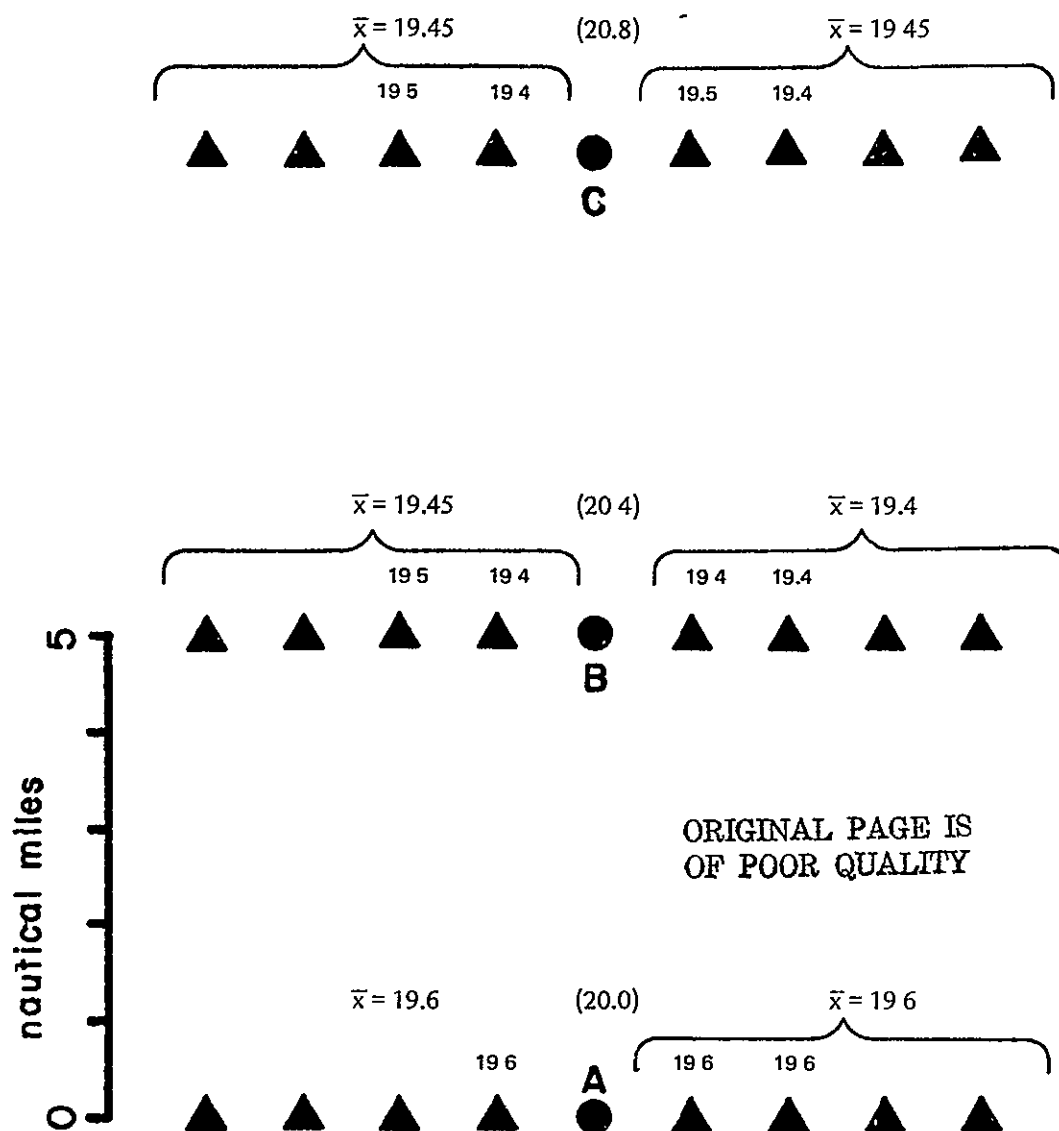
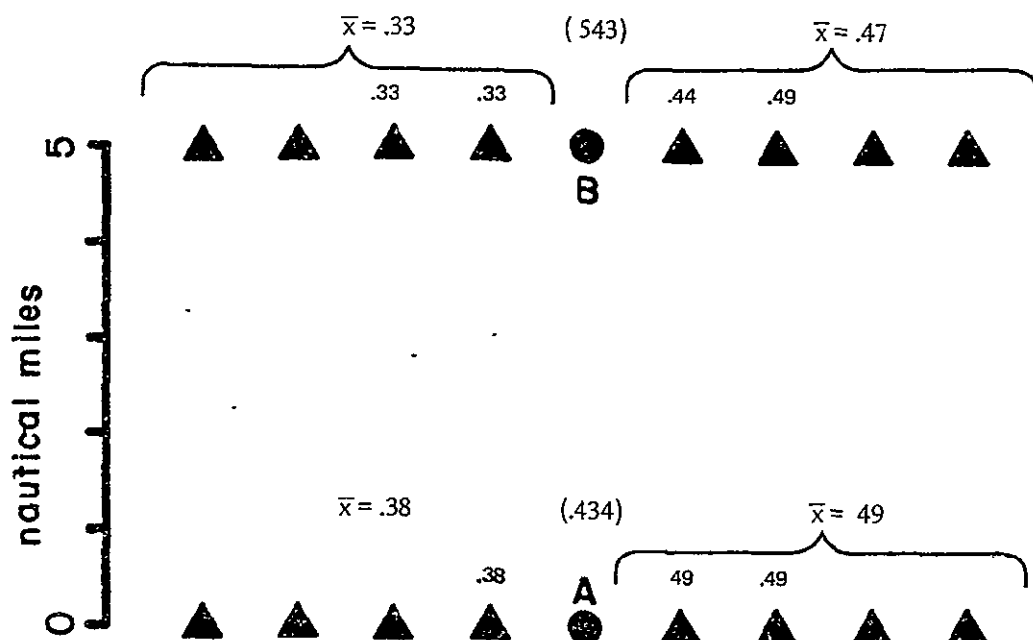
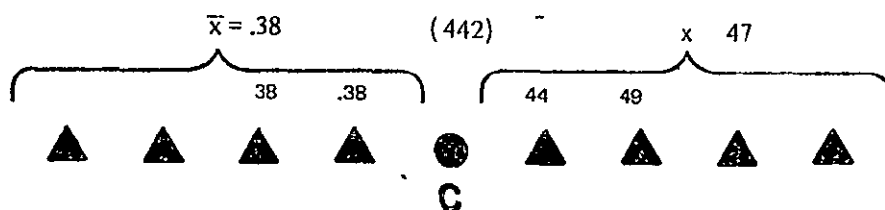
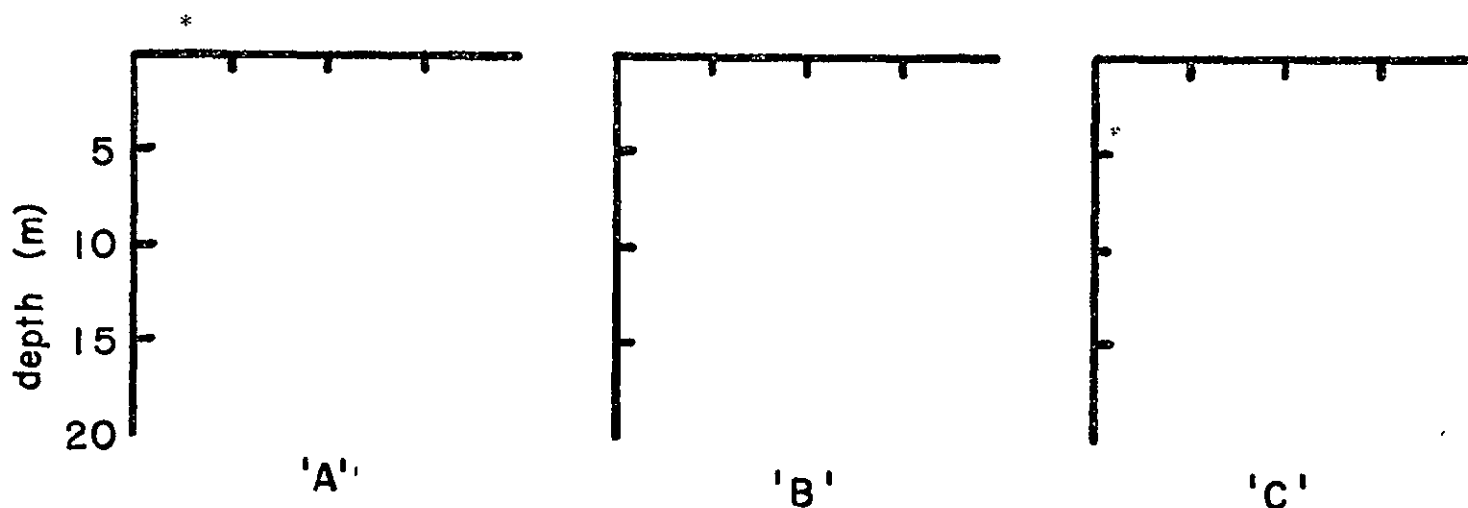


FIG. 9-b SURFACE AND VERTICAL DISTRIBUTION OF TEMPERATURE ($^{\circ}\text{C}$) AT STATION VIII.

● = CALYPSO stations
 ▲ = Zodiac stations



C-2



* one depth reading taken

FIG. 9 -c SURFACE AND VERTICAL DISTRIBUTION OF CHLOROPHYLL A (mg/m^3) AT STATION VIII.

● = CALYPSO stations
 ▲ = Zodiac stations

82

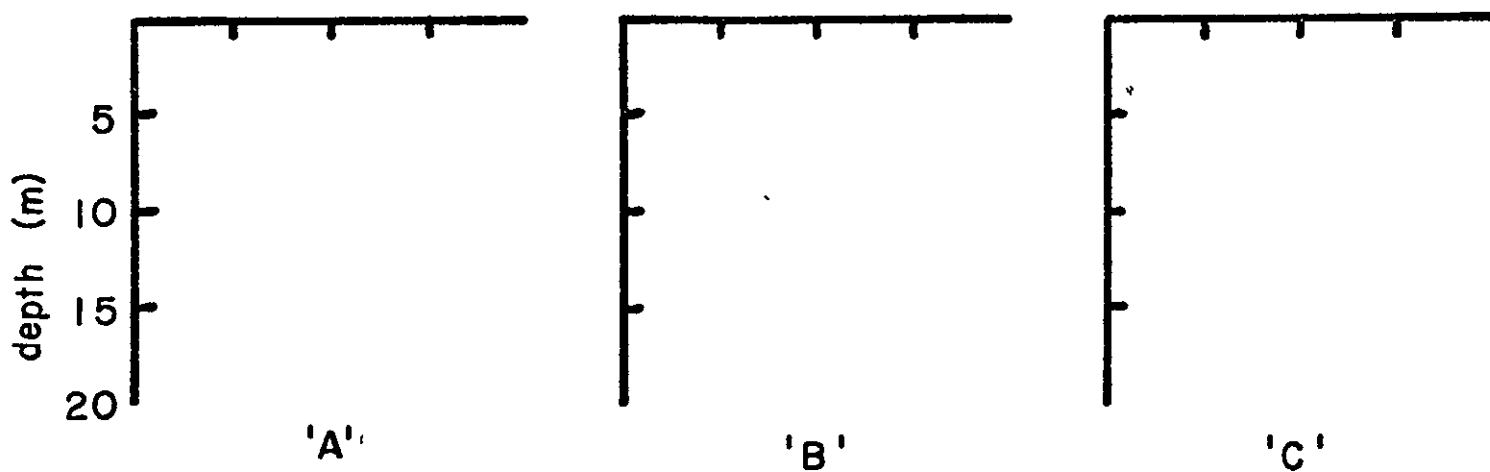
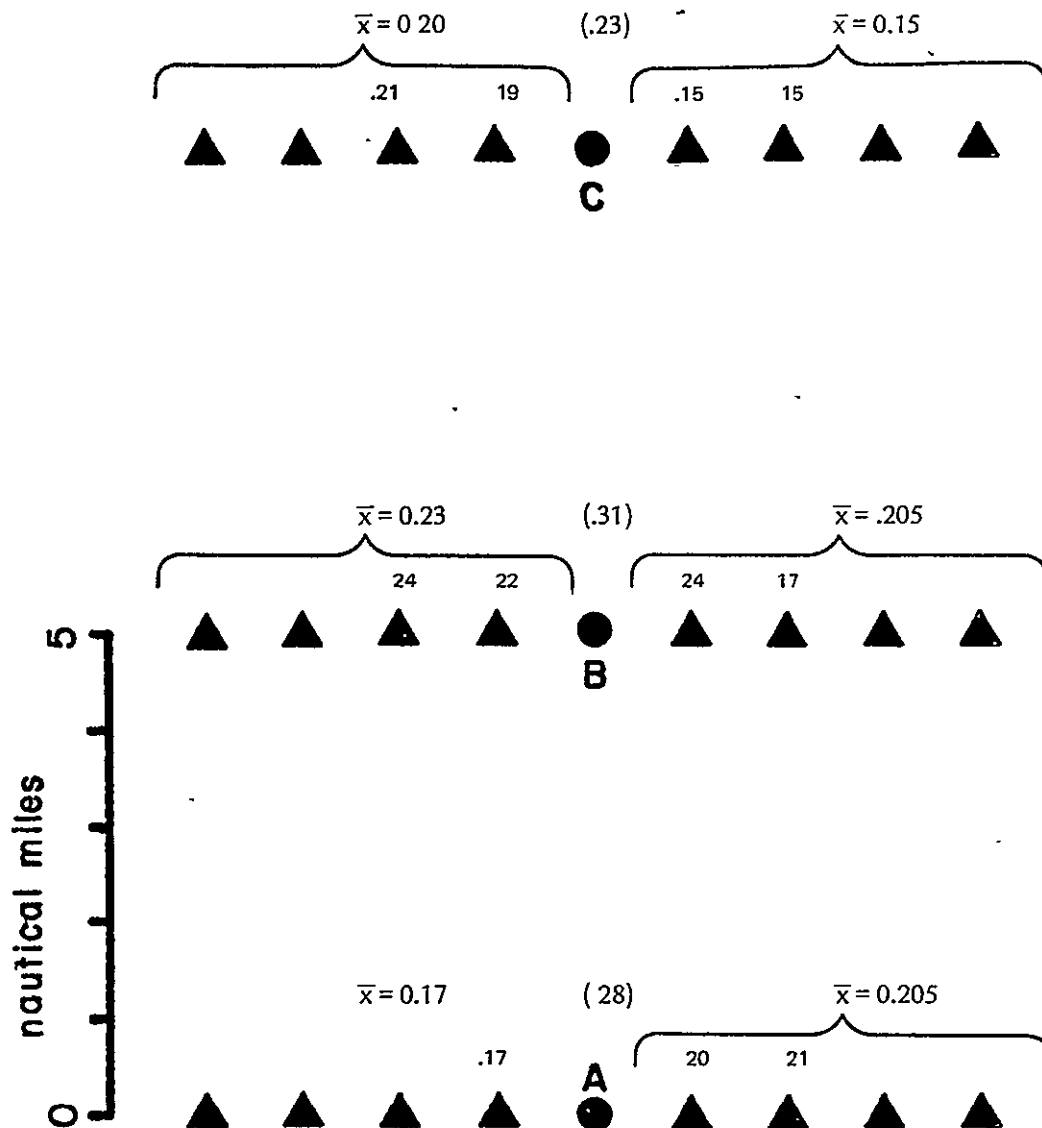


FIG. 9-d SURFACE AND VERTICAL DISTRIBUTION OF PHOSPHATE ($\mu\text{g.at/L}$) AT STATION VIII.

● = CALYPSO stations

83

▲ = Zodiac stations

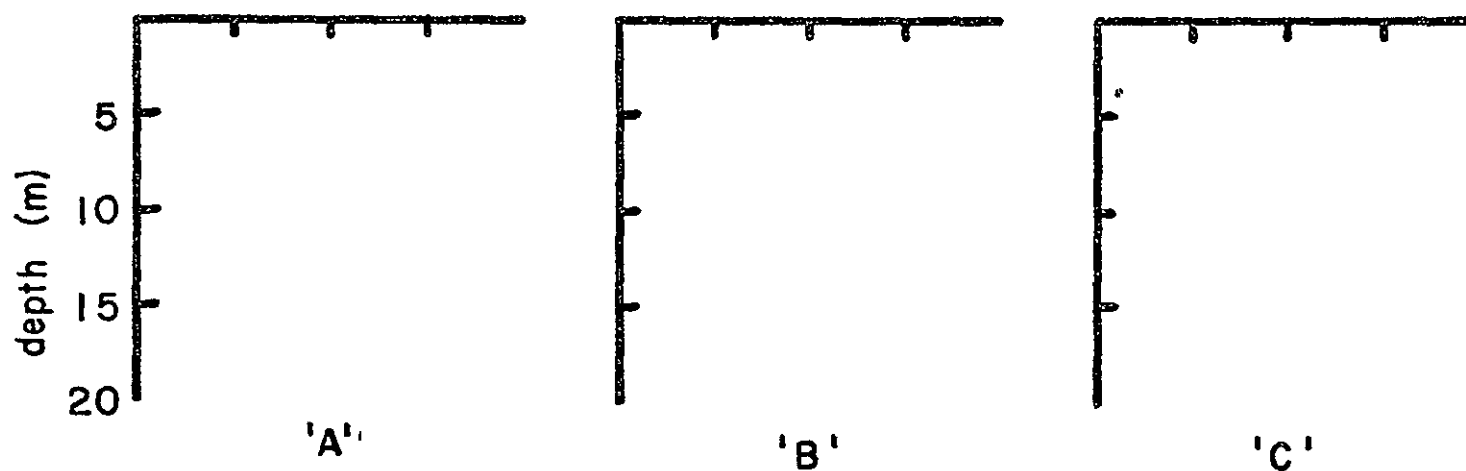
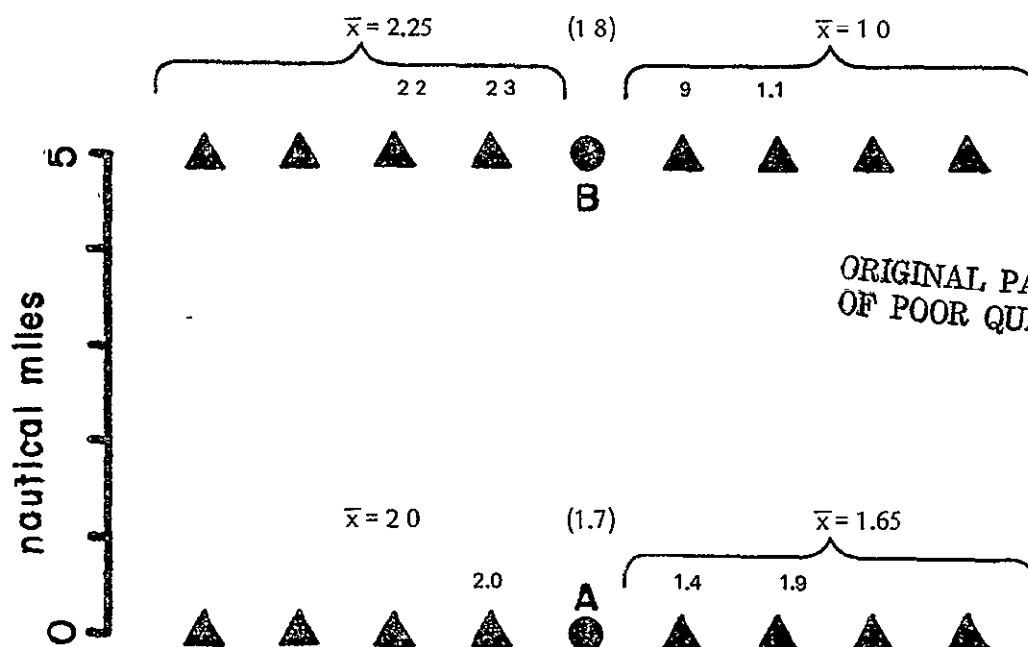
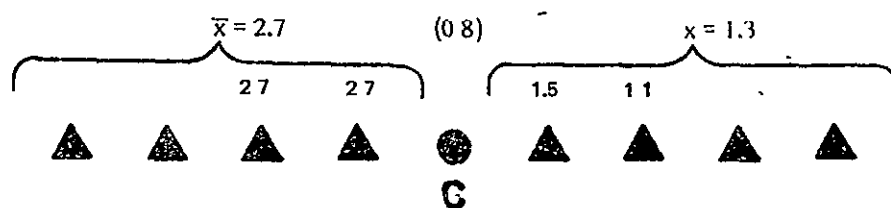


FIG. 9-e SURFACE AND VERTICAL DISTRIBUTION OF SILICATE ($\mu\text{g.at/L}$) AT STATION VIII.

at the CALYPSO and Zodiac stations (all surface samples) also showed no marked variations. As to the nitrates (Fig. 9-f), very few samples were collected at this station to warrant discussion of their distribution.

Leg II

Area investigated: West and Southwest of the Mississippi Delta

Dates: November 26 - December 12, 1974

No. of Stations occupied: 32

During this leg none of the Zodiacs participated in data collection; only the R/V CALYPSO was used in this study. No U-2 overflights were made during this leg. The positions of the stations occupied during this leg are shown in Figure 10.

1. Distribution of Physical, Chemical and Biological Data (Surface) Collected During Leg II

Surface Salinity

In Figure 10 we have plotted the distribution of surface salinity at the stations occupied during this leg. The effect of the Mississippi discharge on the distribution of surface salinity can be easily seen in this figure. Surface salinity at Station 1, occupied near the Southwest Pass, 29.325%. A sudden decrease in surface salinity 28.108% occurred at Station 2, this was followed by a gradual increase westwards, reaching as high value as 35.932% at Station 21.

Surface Temperature

Near the Southwest Pass, sea-surface temperature was relatively low, about 17°C. As the CALYPSO moved westward away from the Mississippi Delta, sea-surface temperatures increased gradually, reaching 23.2°C, at Station 13 (Fig. 11).

● = CALYPSO stations
 ▲ = Zodiac stations

85

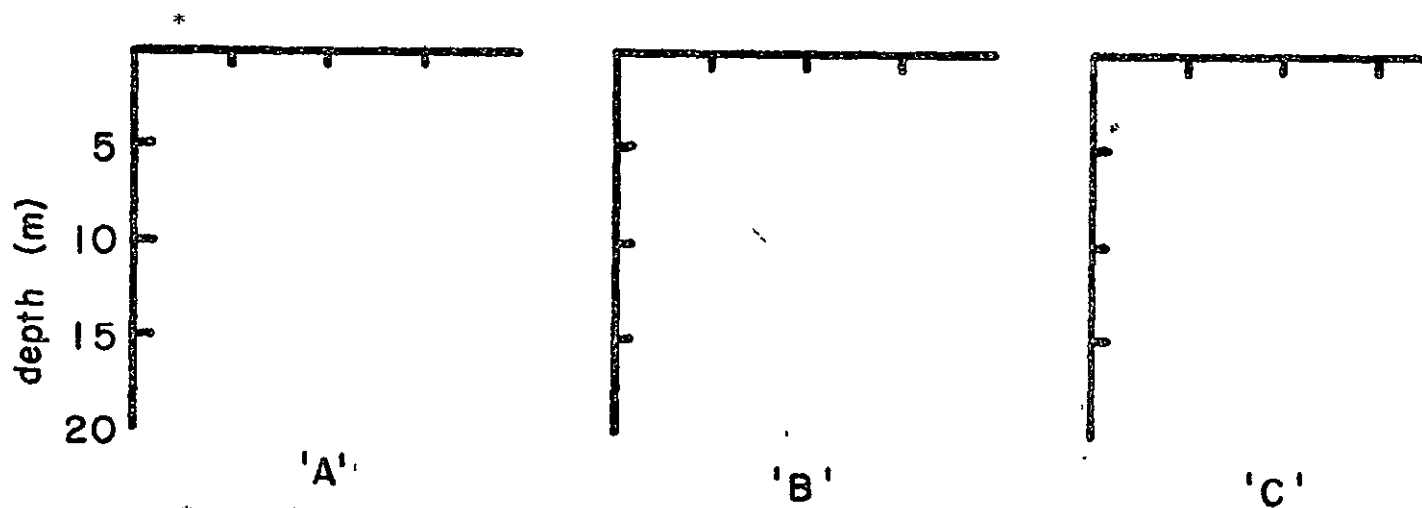
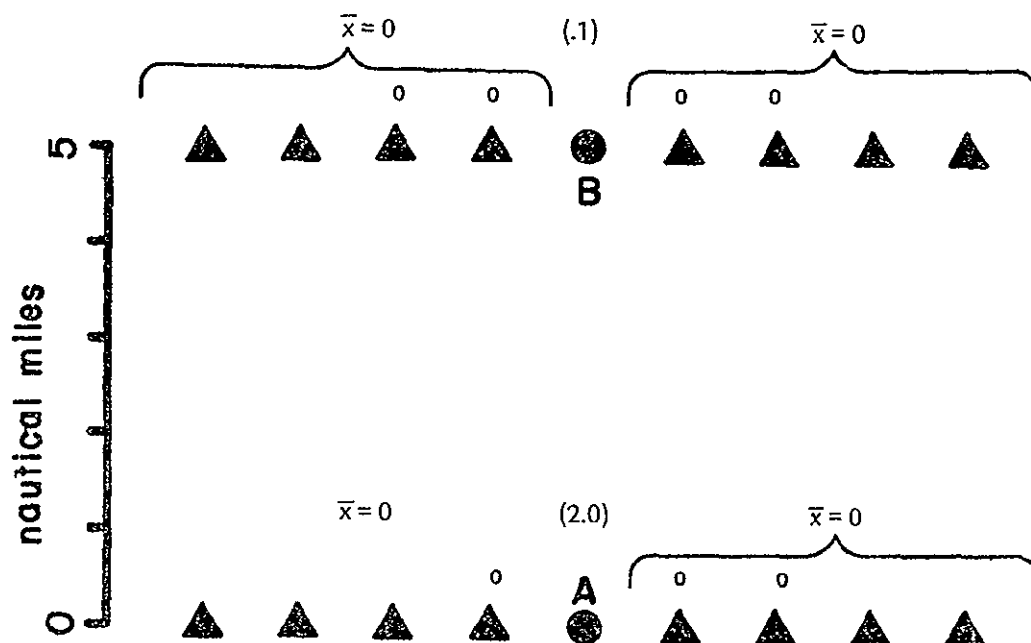
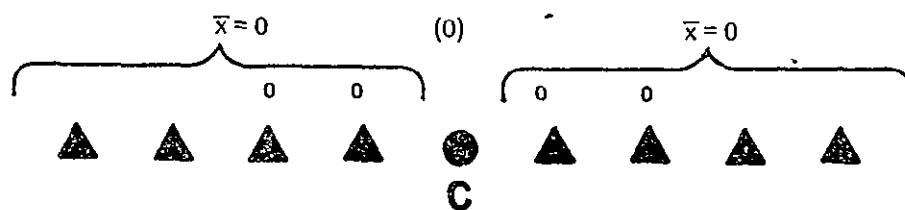


FIG. 9-f SURFACE AND VERTICAL DISTRIBUTION OF NITRATE ($\mu\text{g.at/L}$) AT STATION VIII.

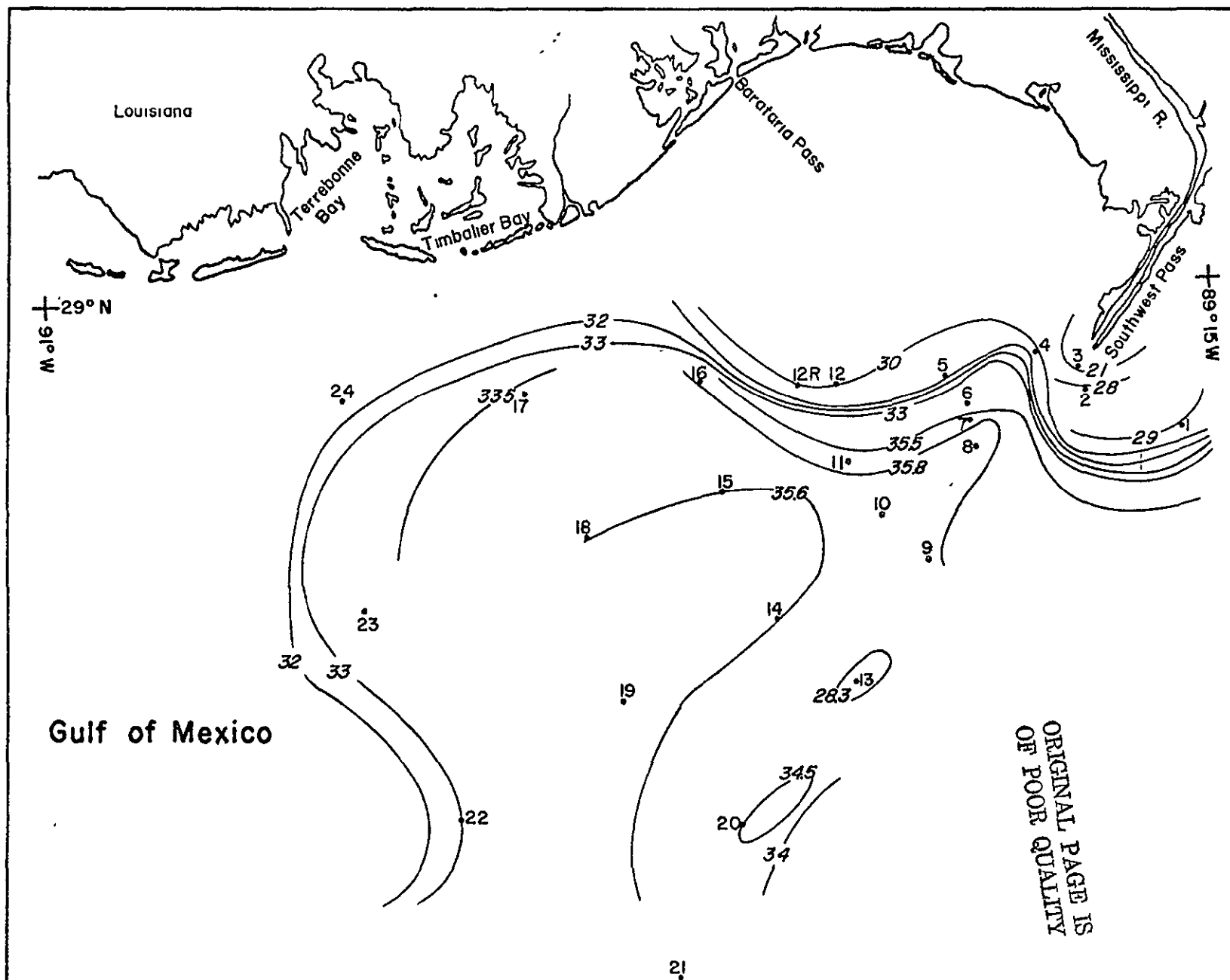


FIG. 10. DISTRIBUTION OF SURFACE SALINITY ($^{\circ}/_{\infty}$) AT THE STATIONS OCCUPIED DURING LEG II OF THE R/V CALYPSO CRUISE.

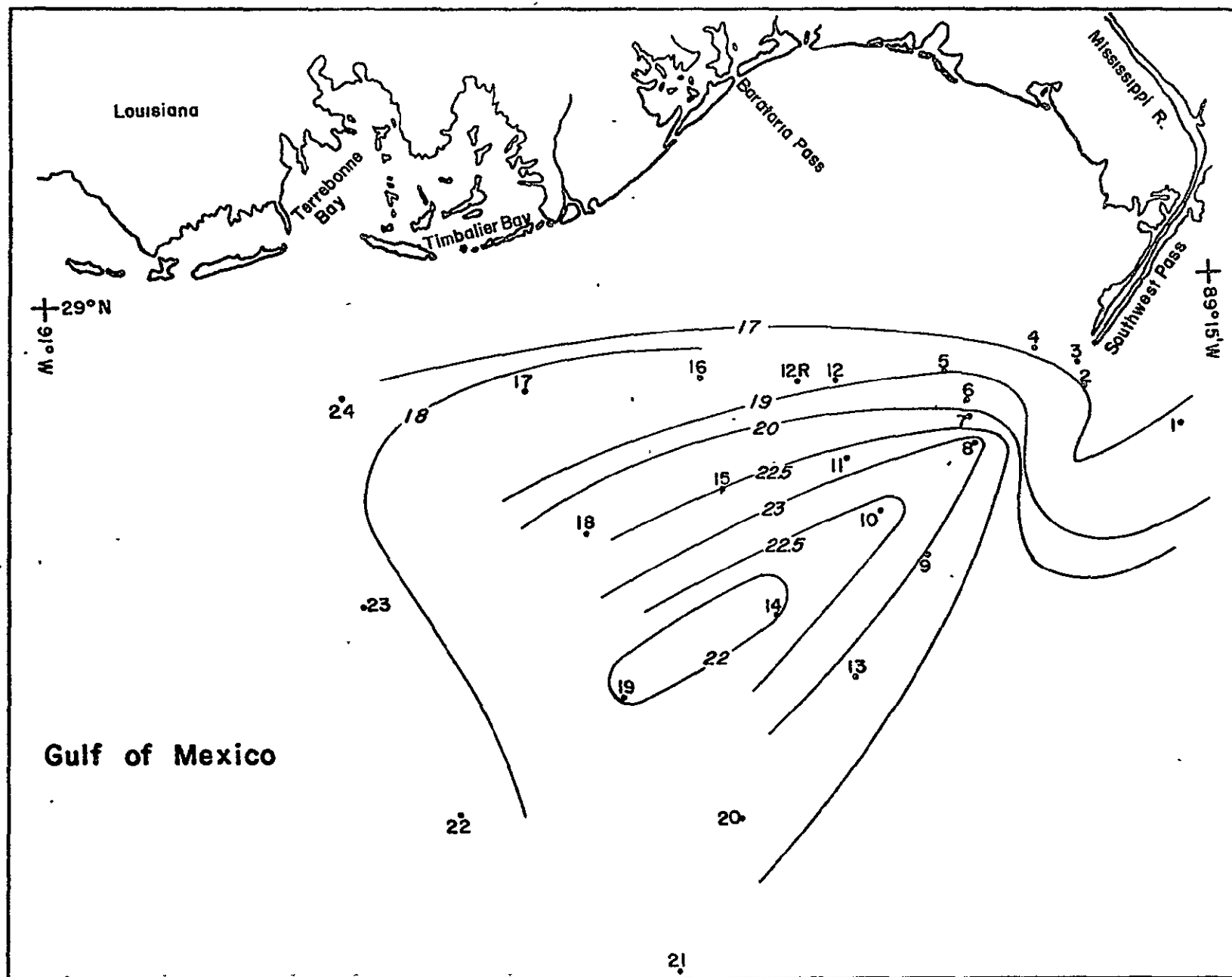


FIG. 11. DISTRIBUTION OF SURFACE TEMPERATURE ($^{\circ}\text{C}$) AT THE STATIONS OCCUPIED DURING LEG II OF THE R/V CALYPSO CRUISE.

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Surface Chlorophyll a

High chlorophyll a values were encountered at the stations occupied off the Southwest Pass with values $> 1.0 \text{ mg/m}^3$ reported from Stations 1, 2, 3 and 4. Gradual decrease in chlorophyll a concentrations were recorded at the offshore stations; the lowest value (0.377 mg/m^3) was reported at Station 13. Pockets of very high chlorophyll a, some reaching as high as 6.37 mg/m^3 at Station 17, were reported from the stations occupied to the north and west of the study area (Fig. 12).

Surface Phosphates

Figure 13 shows high phosphates values (up to $2.77 \text{ } \mu\text{g.at/L}$) at the stations occupied near the Southwest Pass. This was followed by a gradual decrease at the stations occupied west and southwest of the Mississippi Delta. At some of the latter stations, extremely low surface phosphate values ($0.01 \text{ } \mu\text{g.at/L}$) were encountered.

Surface Silicates

In Figure 14 surface silicates show a similar distribution to that of phosphates; namely, very high values ($> 40 \text{ } \mu\text{g.at/L}$) were found at the Southwest Pass Stations, followed by a sharp decline at the stations occupied to the southwest of the Pass. On the other hand, the stations occupied due west of the Pass (e.g. Stations 5, 12 and 16) maintained ~~much~~ higher phosphate values than in the rest of the study area.

Surface Nitrates

The distribution of nitrates in the Mississippi Plume region closely resembled that of silicates and nitrates. In general, very high ($> 25 \text{ } \mu\text{g.at/L}$) values were recorded at the stations occupied nearest the Southwest Pass; this was followed by an abrupt decrease at the stations occupied to the southwest

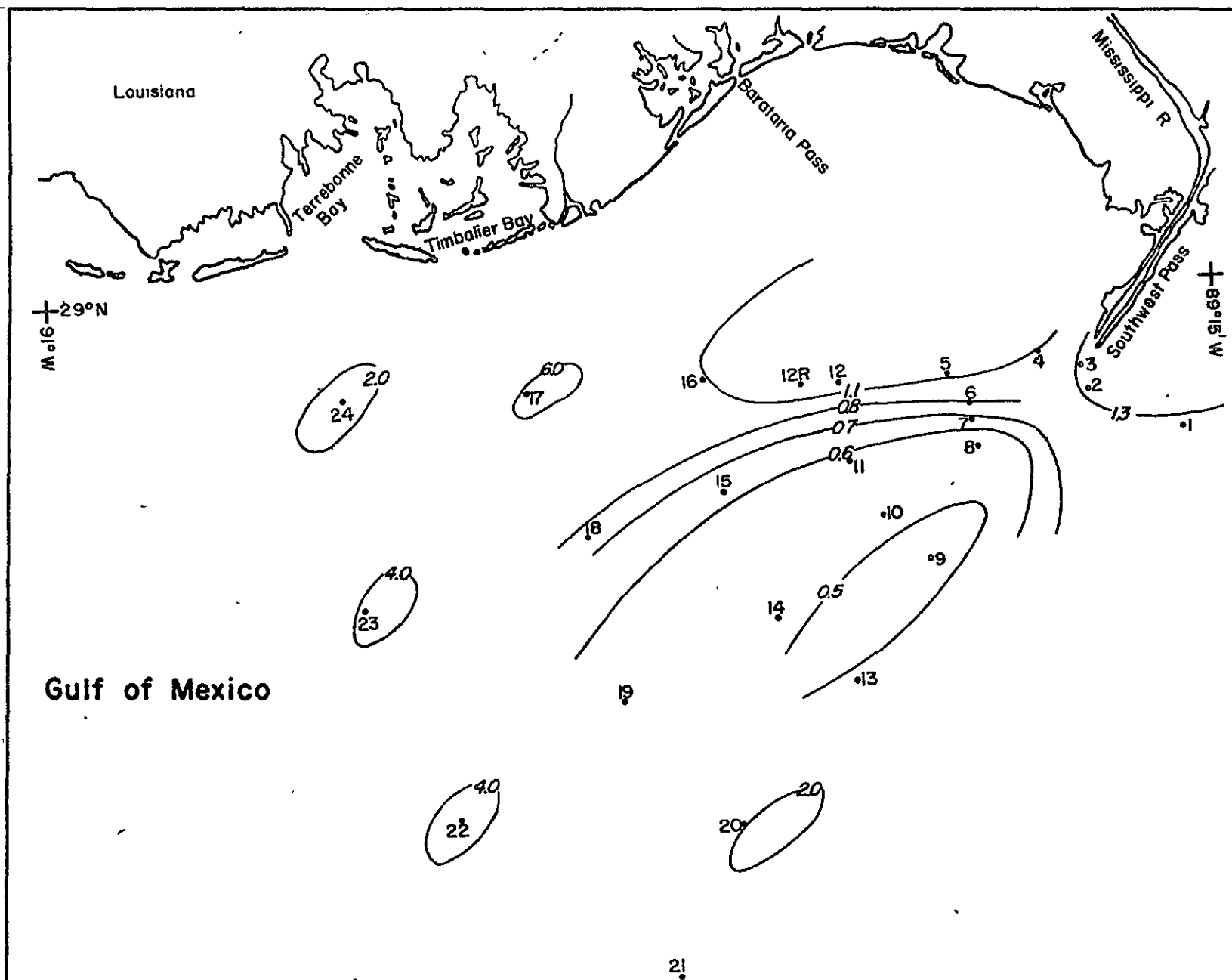


FIG. 12. DISTRIBUTION OF SURFACE CHLOROPHYLL *a* (mg/m³) AT THE STATIONS OCCUPIED DURING LEG II OF THE R/V CALYPSO CRUISE.

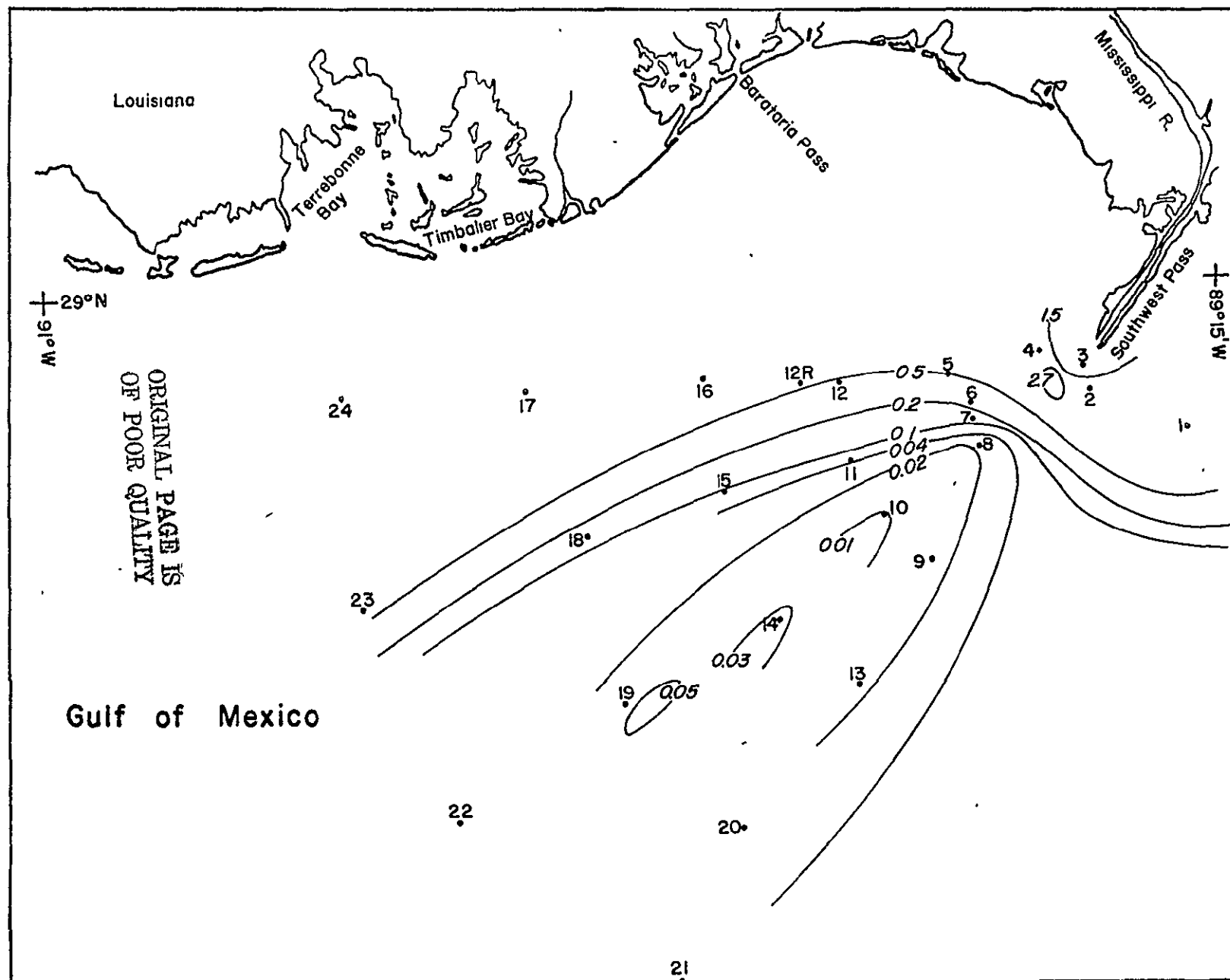


FIG. 13. DISTRIBUTION OF SURFACE PHOSPHATES ($\mu\text{g.at/L}$) AT THE STATIONS OCCUPIED DURING LEG II OF THE R/V CALYPSO CRUISE.

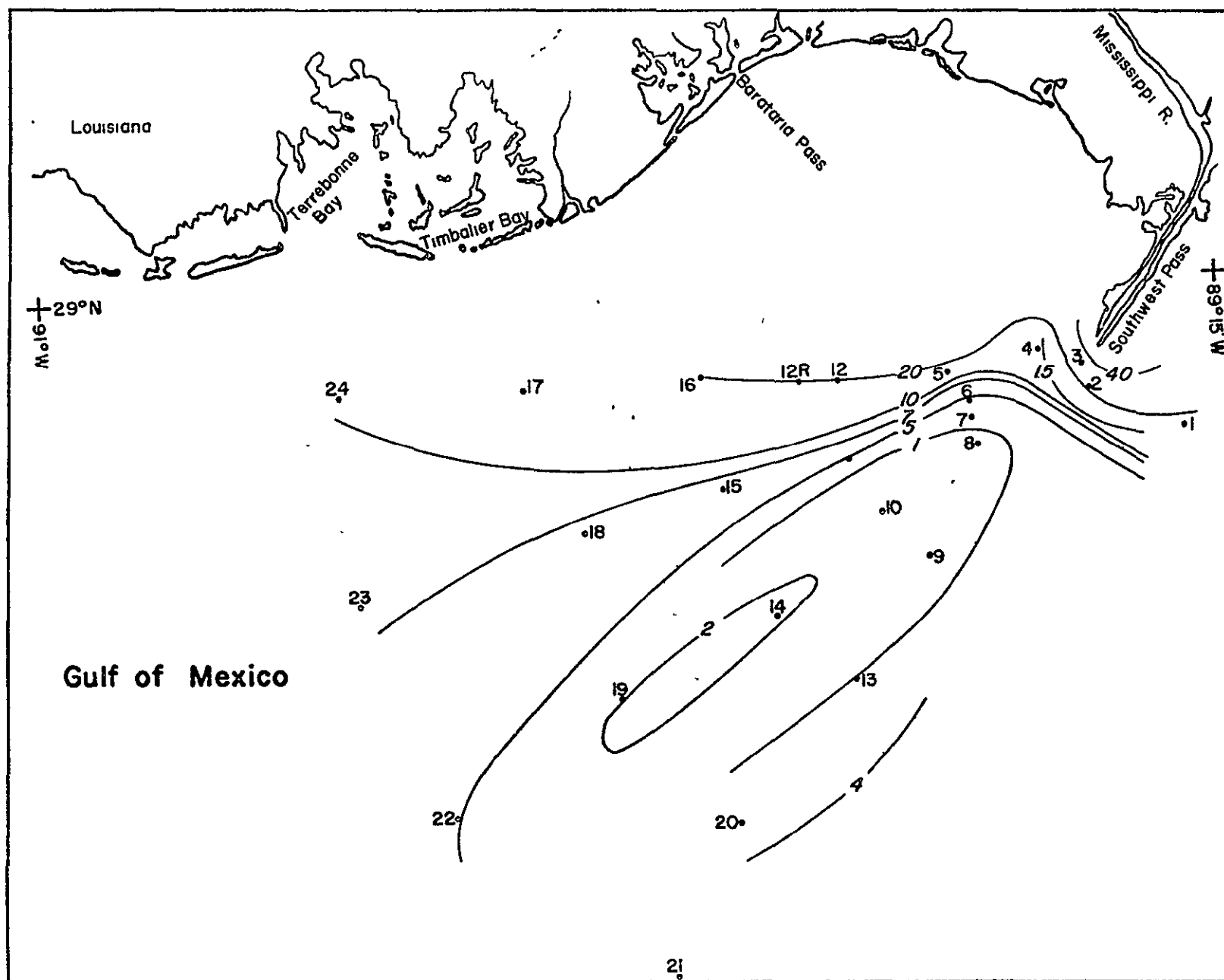


FIG. 14. DISTRIBUTION OF SURFACE SILICATES ($\mu\text{g.at/L}$) AT THE STATIONS OCCUPIED DURING LEG II OF R/V CALYPSO CRUISE.

of the Pass. As with the distribution of silicates, the stations occupied due west of the Pass, exhibited high nitrate values (Fig. 15).

2. Vertical Distributions of Temperature, Salinity, Chlorophyll a and Phosphates at Selected Stations Occupied During Leg II.

Due to the large number of stations occupied during this leg, a few representative stations will be selected in discussing the vertical distribution of salinity, temperature, chlorophyll a and phosphates. The selected stations are: Stations 2, 4, 7, 9, 14, 20, 22 and 23. The distributions of the physical, chemical and biological parameters at each of these stations are discussed below.

Station 2 (Fig. 16)

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Temperature

Vertical distribution of temperature showed a gradual increase with depth from 17.1°C at the surface to 21.6°C at 20 m.

Salinity

The low salinity value observed at the surface (28.108%) was followed by a gradual increase to a depth of 20 m.

Chlorophyll a

Chlorophyll a values showed gradual decrease between 1.319 mg/m³ at the surface to 0.602 mg/m³ at 20 m.

Phosphates

Phosphates values were much higher at the surface than at the sub-surface depths sampled.

Depth of Euphotic Zone

The depth of the euphotic zone was only 6.3 m at this station.

Station 4 (Fig. 17)

Temperature

Showed gradual increase with depth (from 19.6°C at 0 m to 21.9°C at 20 m)

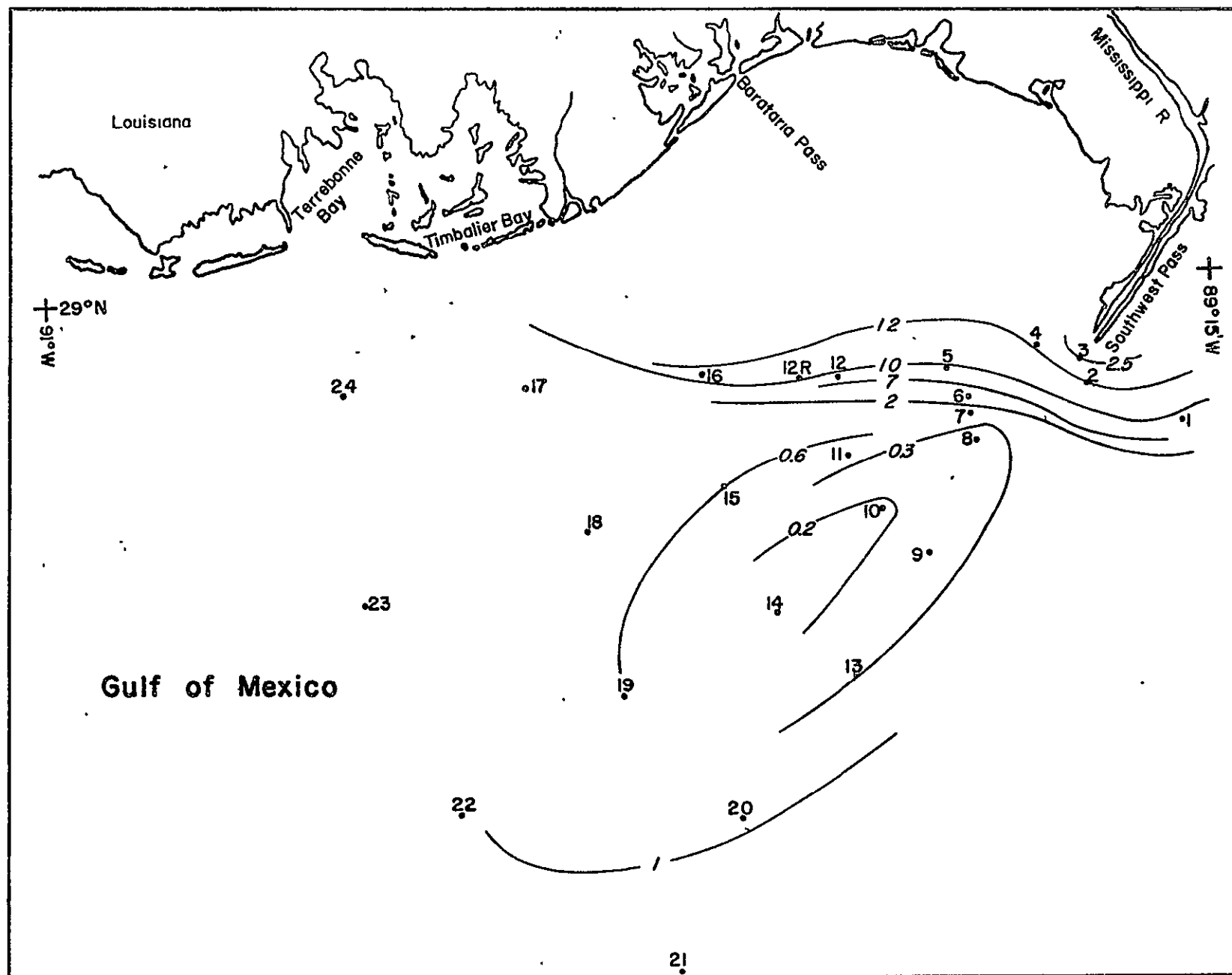


FIG. 15. DISTRIBUTION OF SURFACE NITRATES ($\mu\text{g.at/L}$) AT THE STATIONS OCCUPIED DURING LEG II OF THE R/V CALYPSO CRUISE.

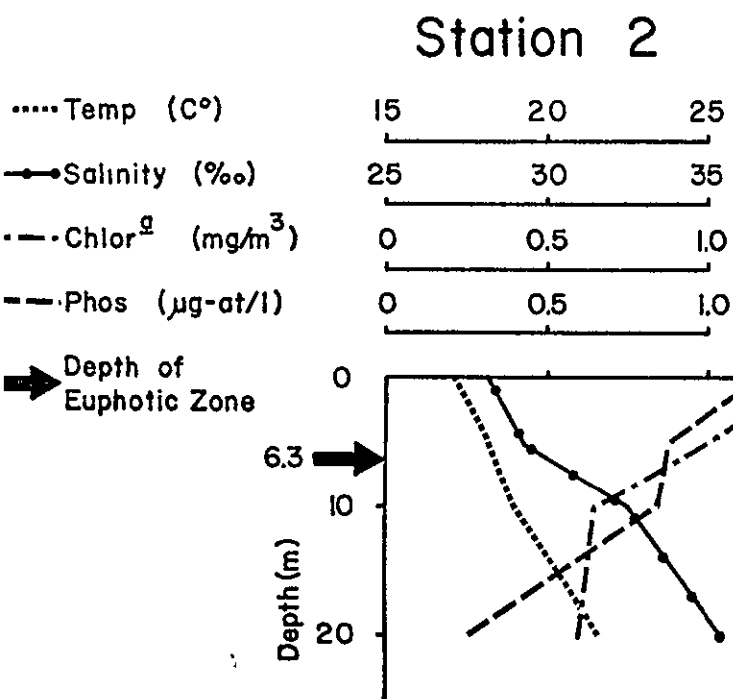


FIGURE 16

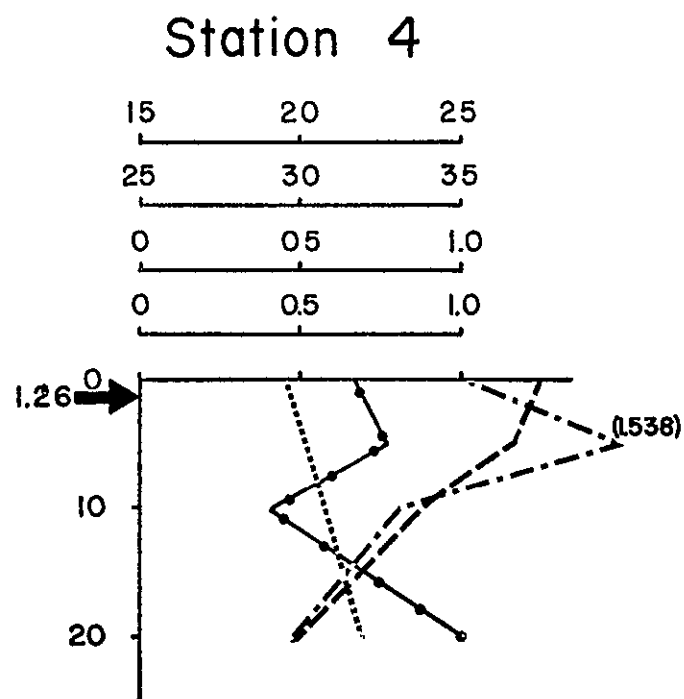


FIGURE 17

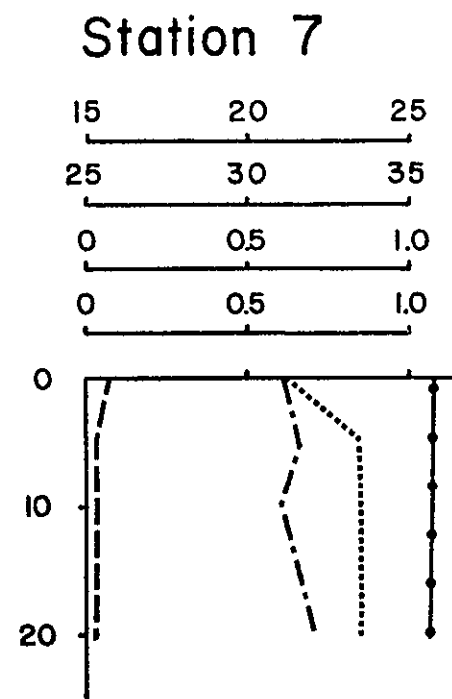


FIGURE 18

FIGS. 16, 17, 18. VERTICAL DISTRIBUTIONS OF TEMPERATURE, SALINITY, CHLOROPHYLL A AND PHOSPHATES AT STATIONS 2, 4 and 7 OCCUPIED DURING LEG II OF R/V CALYPSO CRUISE.

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Salinity

Maximum value (35.172%) found at 20 m.

Chlorophyll a

Maximum value (1.538 mg/m^3) at 5 m, followed by a gradual decrease.

Euphotic Zone

The euphotic zone at this station was the shallowest (1.26 m) encountered during the entire CALYPSO investigation.

Station 7 (Fig. 18)Temperature

Slight increase in temperature between 0 and 5 m, then remained constant.

Salinity

No change between surface and 20 m.

Chlorophyll a

Very slight variation between 0 - 20 m.

Phosphates

Very low phosphate values; only slight changes between surface and 20 m.

Euphotic Zone

30.0 m.

Station 9 (Fig. 19)Temperature

Slight increase between surface and 5 m; then almost isothermal to depth of 50 m.

Salinity

Remained constant between surface and 50 m.

Chlorophyll a

Slight variations with depth.

Phosphate

Extremely low values were recorded at this station.

Euphotic Zone

58.0 m.

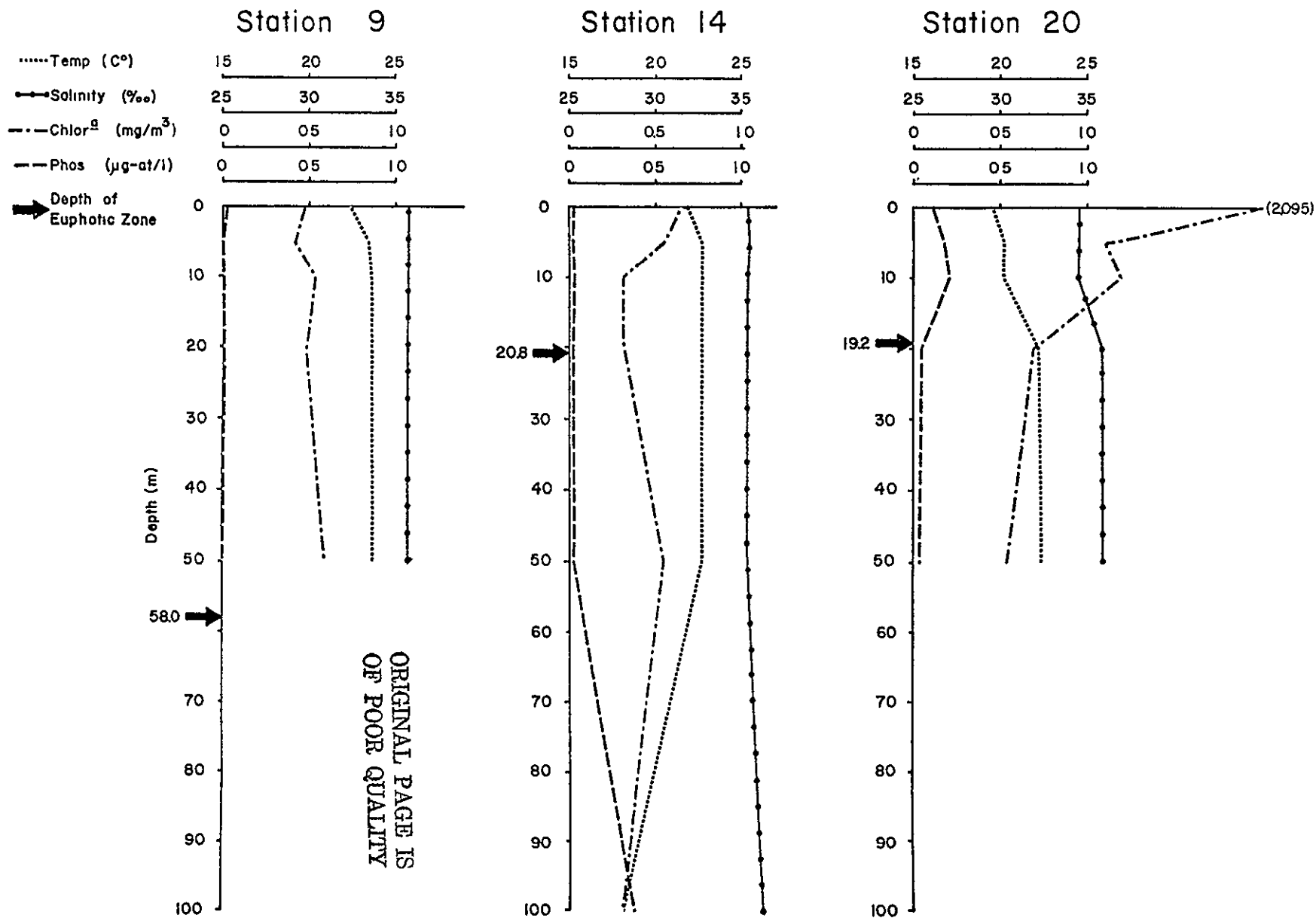


FIGURE 19

FIGURE 20

FIGURE 21

FIGS. 19, 20, 21 VERTICAL DISTRIBUTION OF TEMPERATURES, SALINITY, CHLOROPHYLL A AND PHOSPHATES AT STATIONS 9, 14, 20.

Station 14 (Fig. 20)Temperature

Slight increase between surface and 5 m, isothermal from 5 to 50 m, followed by a gradual decrease between 50 - 100 m.

Salinity

No marked changes in the salinity of the water column studied.

Chlorophyll a

High values at the surface then decreased gradually to 10 m. This was followed by a gradual increase to 50 m; then decreased again at 100 m.

Phosphates

Very low values at the surface and subsurface levels (0 - 50); followed by gradual increase between 50 and 100 m.

Euphotic Zone: 20.8 m

Station 20 (Fig. 21)Temperature

Slight increase in temperature was observed between surface and 20 m; between the latter depth and 50 m temperature remained constant.

Salinity

Salinity increased slightly between 10 and 20 m, then remained constant to depth of 50 m.

Chlorophyll a

Conspicuously high chlorophyll a value was found at the surface (2.1 mg/m^2); this was followed by a marked decline at 20 m, then a gradual decrease to depth of 50 m.

Phosphates

Maximum phosphate values were found at 5 and 10 m; followed by a decrease to the depth of 20 m; phosphate concentrations remained the same between 20 and 50 m.

Euphotic Zone:

19.2 m.

Station 22 (Fig. 22)Temperature:

Temperature showed a gradual increase with depth (0.40 m).

Salinity

Salinity distribution in the upper 40 m of the water column followed the same pattern as temperature.

Chlorophyll

The highest chlorophyll value was at the surface; this was followed by a gradual decline.

Phosphates

Maximum values at 10 m, followed by a gradual decline between 10 and 20; then remained constant to 40 m.

Euphotic Zone

15.2 m.

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Station 23 (Fig. 22)Temperature and Salinity

Both parameters showed slight increase between 0 and 10 m; this was followed by noticeable increases between 10 and 20 m.

Chlorophyll a

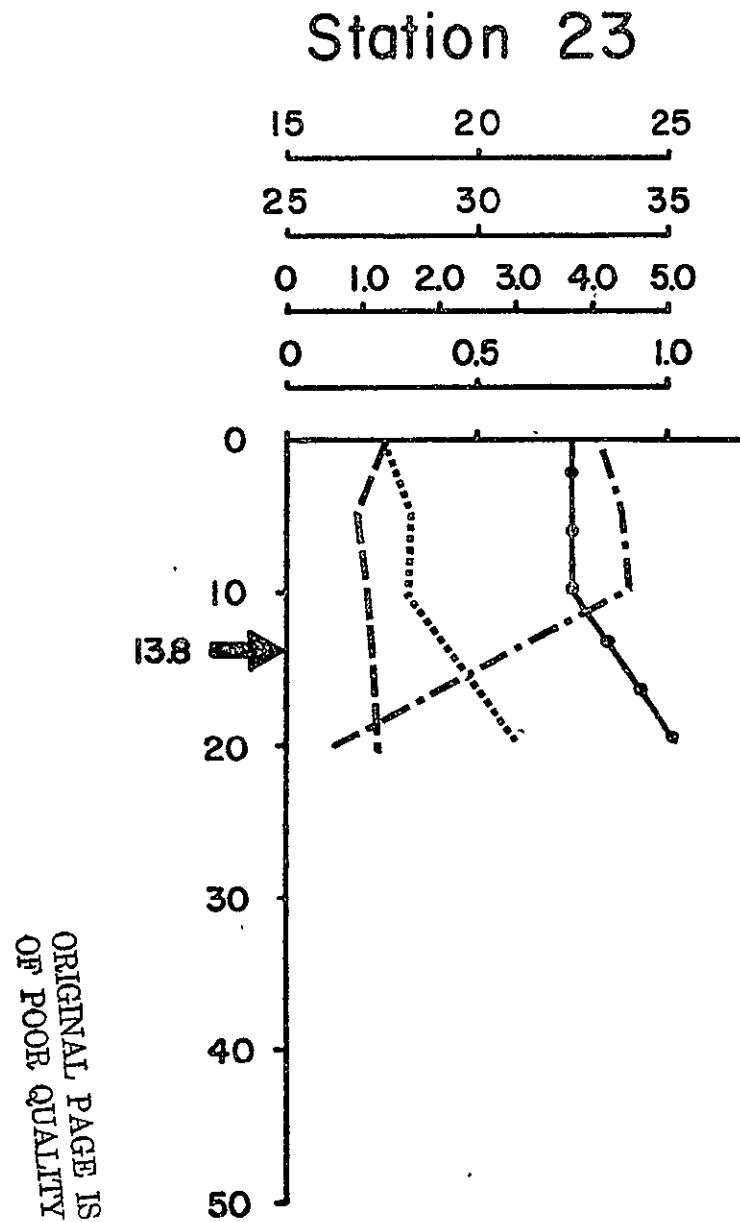
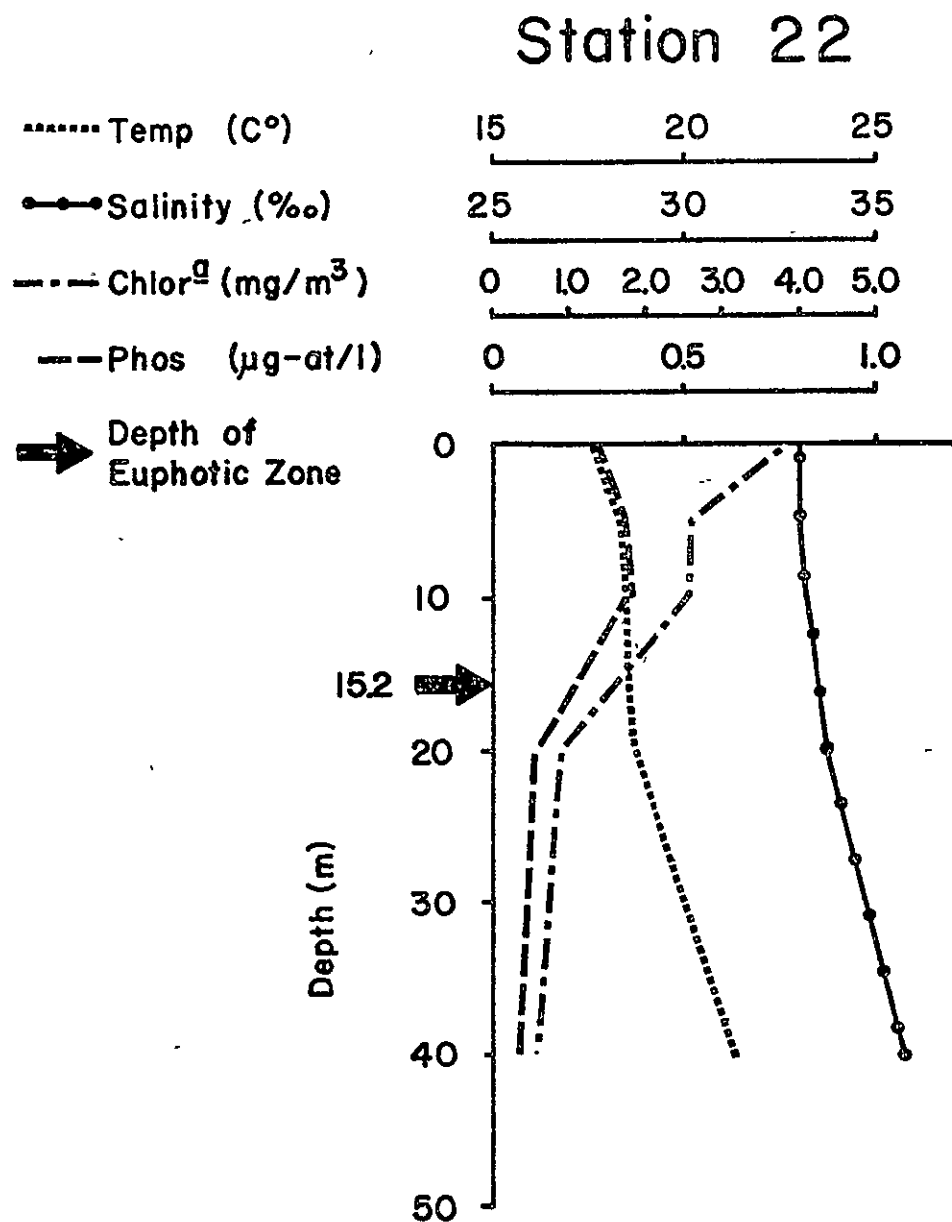
Chlorophyll values increased slightly between surface and 10 m; marked decrease was evident between 10 and 20 m.

Phosphates

Slight changes between surface and 20 m were observed.

Euphotic Zone

13.8 m.



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FIG. 22. VERTICAL DISTRIBUTION OF TEMPERATURE, SALINITY, CHLOROPHYLL A AND PHOSPHATES AT STATIONS 22 and 23.

Leg III

Area investigated: Between Contoy Island and the Florida Keys

Dates: February 20 - 25, 1975

No. of Stations Occupied: 9

As in Leg II, only the R/V CALYPSO was used in data gathering; no data were collected by the Zodiacs, no U-2 overflights were made, either. The positions of the stations occupied during this leg are shown in Figure 1.

A brief description of the vertical distribution of temperature, salinity, chlorophyll a, and phosphates at the stations occupied during this leg is given below. Of the parameters studied during this leg, that of temperature was measured to depth of 450 m; the rest of the parameters were studied at 0, 5, 10, 15, 25, 50, 75 and 100 m.

Station X (Fig. 23)Temperature

Slight increase in temperature between surface and 5 m; this was followed by a gradual decrease to depth of 450 m.

Salinity

Following the gradual increases between 0 and 50 m, salinity then varied very little between 50 and 100 m.

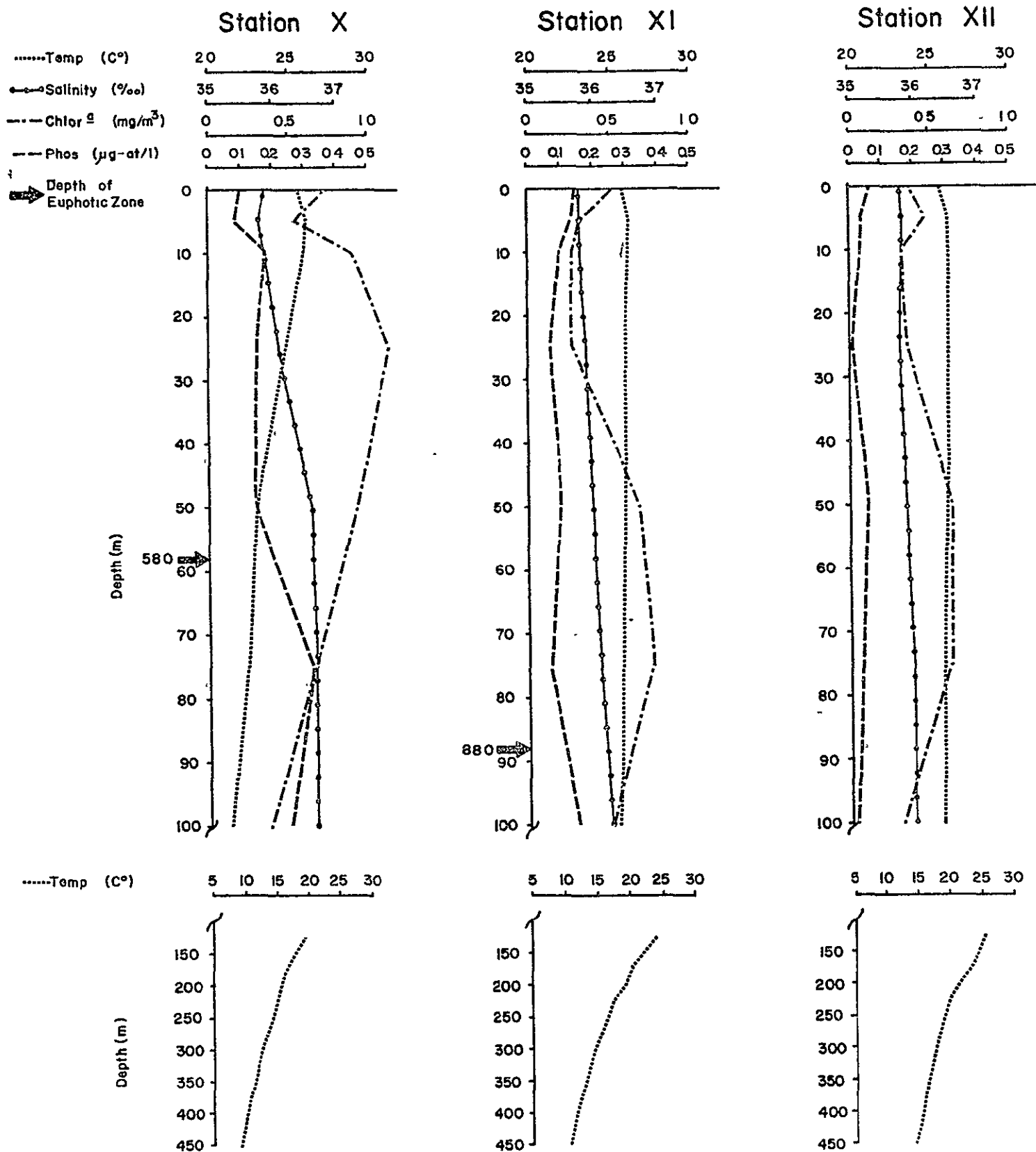


FIGURE 23

FIGURE 24

FIGURE 25

Chlorophyll a

Maximum values occurred at 25 m; this was followed by a gradual decrease to depth of 100 m.

Phosphates

Values increased between surface and 10 m; remained constant between 10 and 50 m, followed by a marked increase between 50 and 100 m.

Euphotic Zone

58.0 m.

Station XI (Fig. 24)Temperature

Remained almost constant between 0 and 100 m, followed by a gradual decrease to 450 m.

Salinity

Slight increase in the salinity values between 0 and 100 m.

Chlorophyll a

Possibly there are two chlorophyll maxima; one at surface and the other at 75 m.

Phosphates

Only minor variations, with a slight tendency for increase in values with depth.

Euphotic Zone

88.0 m.

Station XII (Fig. 25)

The distribution of temperature, salinity, chlorophyll and phosphates at this station showed remarkable resemblance to those obtained at the preceding station (Station XI).

Stations XIII, XIV, and XV (Fig. 26)

Temperature

At Station XV, temperature varied very little in the upper 100 m. At Station XIV a not-so-well defined thermocline can be detected between 10 and 45 m. At the three stations shown in the above figure, marked decrease in temperature was noted between 100 and 450 m.

Salinity

Salinity remained almost constant in the upper 100 m; some increase was noted between 0 and 5 m at Station XV.

Chlorophyll a

Some variations in chlorophyll a concentrations with depth were evident; maximum chlorophyll values varied between 25 m, 75 and 100 m.

Phosphates

Generally very low; some variations between 0 and 25m; then remained constant between 25 and 100 m.

Euphotic Zone

The depth of the euphotic zone at Station XIII (78.0 m) truly reflects the oceanic conditions typical for this leg.

Stations XVI, XVII and XVIII (Fig. 27)

Temperature

Remained almost constant between 0 and 100 m at Stations XVI and XVII. A weak thermocline can be detected between 25 and 50 m at Station XVIII. Lower temperatures were recorded between 100 and 400 m.

Salinity

Very slight variations in salinity values with depth.

Chlorophyll a

Minor variations in chlorophyll values were found in the upper 50 m; maximum values were recorded at 75 and 100 m.

Phosphates

Low values in general; some variations between 0 and 50 m.

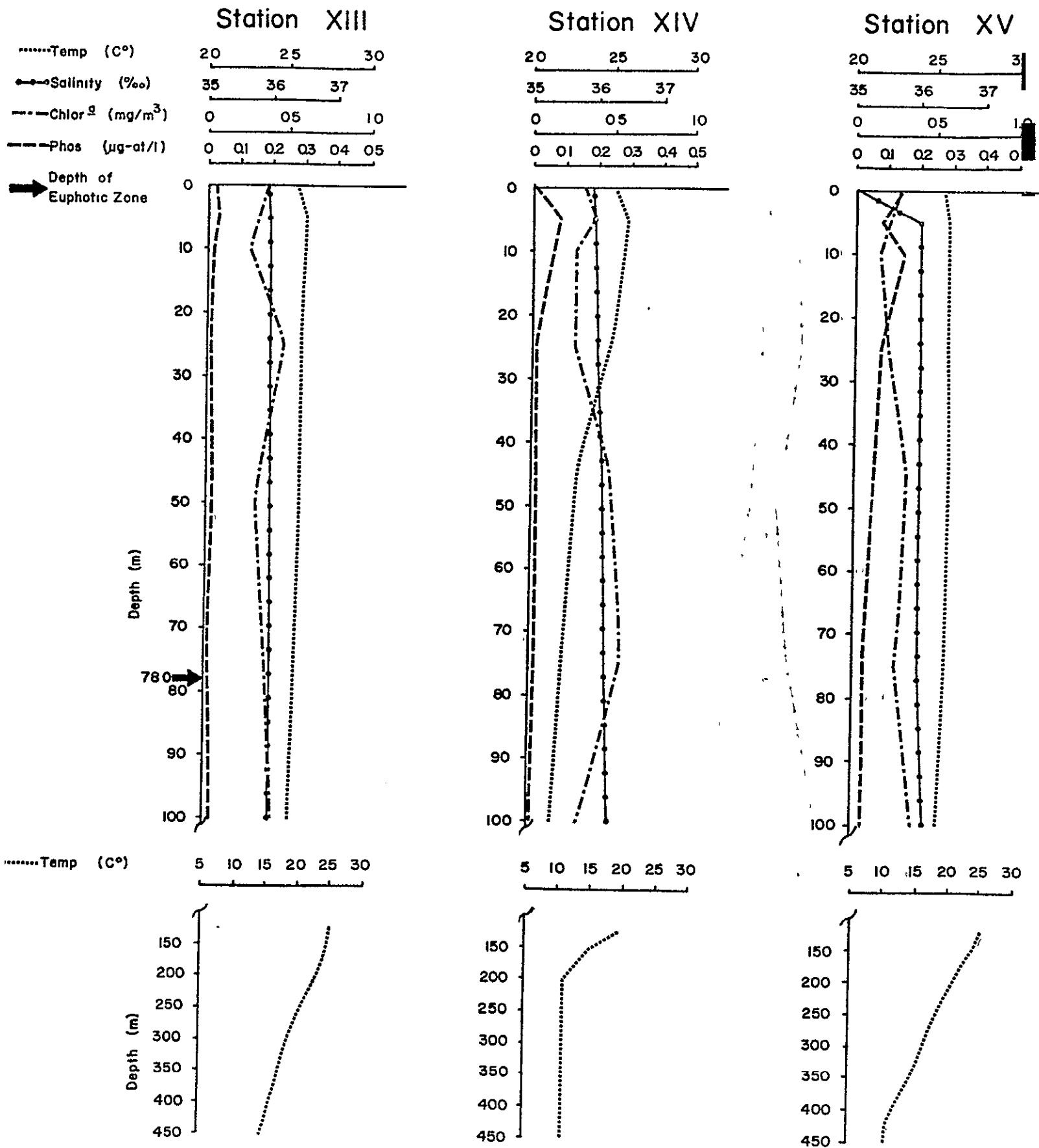
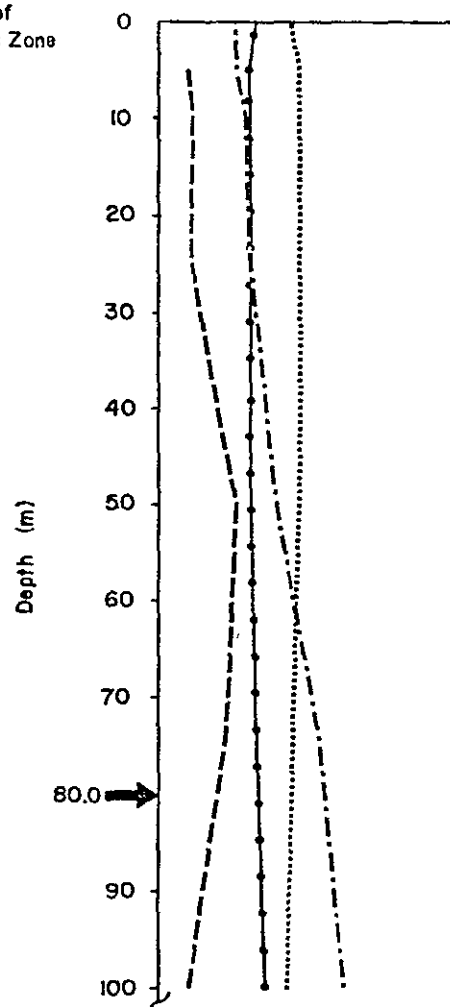


FIG. 26 VERTICAL DISTRIBUTION OF TEMPERATURE, SALINITY, CHLOROPHYLL A AND PHOSPHATES AT STATIONS XIII, XIV, AND XV

Station XVI

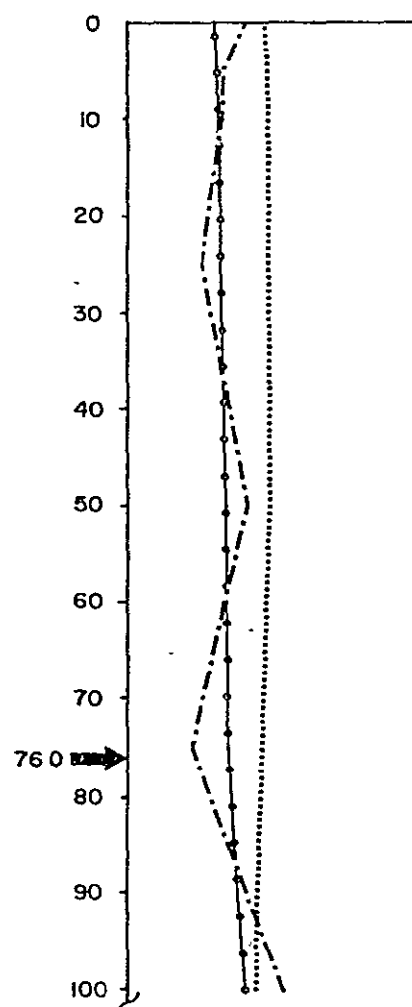
.....Temp (C°) 20 25 30
 ---●---Salinity (‰) 35 36 37
 - - - - -Chlor^a (mg/m³) 0 05 10
 - - - - -Phos (μg-at/l) 0 01 02 03 04 05

➡ Depth of
Euphotic Zone



Station XVII

.....Temp (C°) 20 25 30
 ---●---Salinity (‰) 35 36 37
 - - - - -Chlor^a (mg/m³) 0 05 10
 - - - - -Phos (μg-at/l) 0 01 02 03 04 05



Station XVIII

.....Temp (C°) 20 25 30
 ---●---Salinity (‰) 35 36 37
 - - - - -Chlor^a (mg/m³) 0 05 10
 - - - - -Phos (μg-at/l) 0 01 02 03 04 05

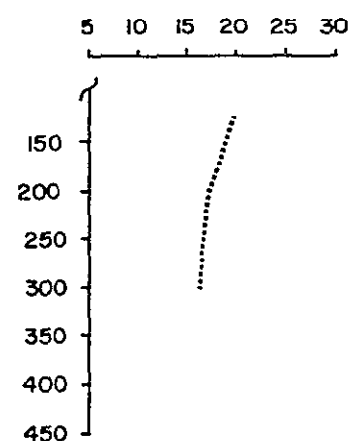
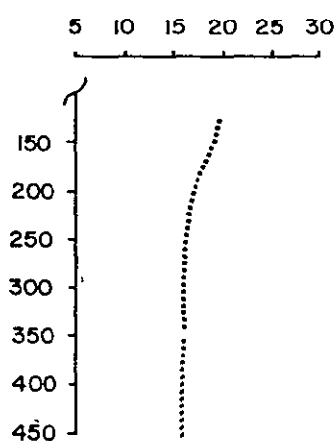
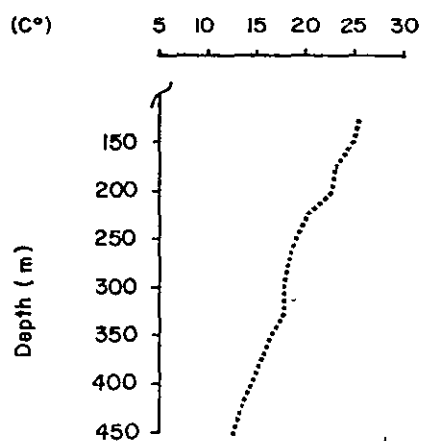
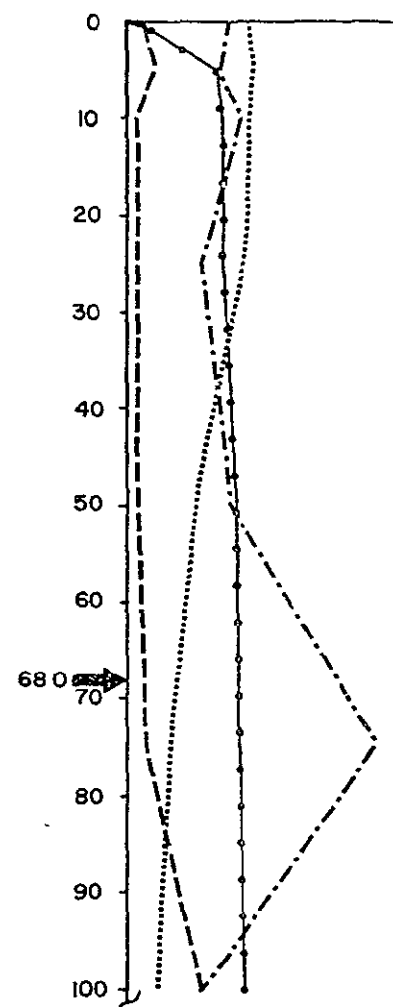


FIG. 27 VERTICAL DISTRIBUTION OF TEMPERATURE, SALINITY, CHLOROPHYLL A AND PHOSPHATES AT STATIONS XVI, XVII AND XVIII

Euphotic Zone

As at Station XIII, the euphotic zones at Stations XVI, XVII and XVIII were deep; their values were: 80.0, 76.0 and 68 m, respectively.

2. Species Composition of Phytoplankton

The species composition and relative abundance of the net phytoplankton collected at CALYPSO Stations II, III and IV, during Leg I are given in Table 22.

The total number of species found in this study was about 154 (with uncertainty due to the number of unidentified species in many genera), with an average of 59 found at each station. If number of species is considered a measure of diversity, Stations II-A, III-B, IV-A and IV-B were less diverse than average; Stations II-B, II-C, III-A, III-C and IV-C were more diverse than average. The highest number of species at a single station was 66 at Station III-C, and the lowest number was 54 at Stations IV-A and IV-B. It is possible that a coarse meshed cod-end of the net was used at the Stations IV-A, B, and C, since many of the diatoms found there were chain-formers.

The blue-green algae were dominant in Stations II-C, IV-B, and IV-C and abundant in Station II-B and III-C. Especially notable among the diatoms were the populations of Chaetoceros spp., especially C. decipiens and C. lorenzianum, both large-celled species. Thalassionema nitzschioides was abundant at Station III-A and common at most other stations. More small Thalassiosira spp. were present than one would expect from a 35 μm mesh net tow. Obviously the net retains some material 10 μm in diameter and less.

Dinoflagellates occurred in small numbers, being rare in some cases of occurrences. Seven species were found in Station II-C and six in Station III-C.

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The araphid diatoms (e.g., Cymatosira lorenziana, Dimerogramma spp.) as well as some of the pennate diatoms with raphes (e.g., Amphora spp., Nitzschia sigmaformis) marked these samples as containing tythropelagic forms stirred up by turbulent inshore waters. Although neritic forms were noted (e.g., Skeletonema spp., Thalassiosira eccentrica, Nitzschia pungens), they were not abundant in the samples.

In general, the samples are to be noted for the large number of species present in small populations and the mixture of truly planktonic and benthic forms.

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TABLE 22. PHYTOPLANKTON SPECIES COLLECTED IN NET HAULS AT STATIONS
II, III, AND IV OF LEG I OF THE CALYPSO
CRUISE

DIATOMS	Stations								
	II			III			IV		
	A	B	C	A	B	C	A	B	C
<u>Acnanthes</u> sp. cf. <u>tenuis</u> Hust.						R			
<u>Actinocyclus</u> <u>octonarius</u> Ehrenb.	R	R		I	R	I	R	R	
<u>A.</u> sp.		I		R	R	R			
<u>Actinoptychus</u> <u>senarius</u> (Ehrenb.) Ehrenb.	R	R		R	R	R	R		R
<u>Amphora</u> <u>bigibba</u> Grun.	R	R	R			R		R	
<u>Amphora</u> <u>ocellata</u> Donk.		R							
<u>A. proboscidea</u> (Greg.) Cleve	R		R		R				
<u>A.</u> sp. 1	R					R			
<u>A.</u> spp. (unidentified)	R	R	I		I			R	R
<u>Asterionella</u> <u>glacialis</u> Castr.								I	
<u>Bacteriastrum</u> <u>cosmosum</u> Pav.			R				O		
<u>B. delicatulum</u> Cleve	I		R	R		I	O	O	I
<u>B.</u> spp. (unidentified)	R	I	I	I	R		I		I
<u>Biddulphia</u> <u>aurita</u> (Lyngbe) Breb. & Godey		R	R			R			
<u>B. dubia</u> (Brightw.) Cleve		R							
<u>B. mobiliensis</u> Bail.				R			I	R	R
<u>B. regia</u> (Schultze Ostenf.							I		
<u>B. rhombus</u> (Ehrenb.) Wm. Sm.				R					
<u>B. sinensis</u> Grev.							R		
<u>Campylodiscus</u> <u>fastuosus</u> Ehrenb.				R					
<u>Campylosira</u> <u>cymbelliformis</u> (A. S.) Grun.		R						R	
<u>Cerataulina</u> <u>pelagica</u> (Cleve) Hendey	R		R	I			I	I	I
<u>Chaetoceros</u> <u>affine</u> Laud.				O	R	R	I		
<u>C. breve</u> Schütt		C		I		F	O		I
<u>C. coarctatum</u> Laud.				I	R				
<u>C. compressum</u> Laud.	I	R		I	R	R			I
<u>C. curvisetum</u> Cleve				I					R
<u>C. decipiens</u> Cleve	F	C	C	C	F	C	C	C	C

	Stations								
	II			III			IV		
	A	B	C	A	B	C	A	B	C
DIATOMS, cont.									
<u>Chaetoceros didymum</u> Ehrenb.	C	I	I	I			R		
<u>C. diversum</u> Cleve					R	I	I	R	
<u>C. laciniosum</u> Schütt	O	O	I						
<u>C. lorenzianum</u> Grun.	C	C	C	O	O	I	C	C	O
<u>C. peruvianum</u> Brightw.	R	R					R		R
<u>C. pseudocurvisetum</u> Mangin						R	O		
<u>C. spp.</u> (unidentified)	I	I	I	O	O	I	C	O	R
<u>C. resting cells</u>	I	I	O						R
<u>Cocconeis</u> sp. cf. <u>disculoides</u> Hust.						I			
<u>C. sp.</u> cf. <u>thumensis</u> A. Mayer				R					
<u>C. spp.</u>	R	I				R			R
<u>Corethron criophilum</u> Castr.	R	R			R	R	I		
<u>Coscinodiscus asteromphalus</u> Ehrenb.				I			R		
<u>C. granii</u> Gough					R				
<u>C. jonesianus</u> (Grev.) Ostenf.				R					
<u>C. marginatus</u> Ehrenb.				R					
<u>C. nitidus</u> Greg.		R							
<u>C. radiatus</u> Ehrenb.			R	I		I	I	R	R
<u>C. spp.</u> (unidentified)				I	I	I	I	R	
<u>Cyclotella meneghiniana</u> Kutz.				O					
<u>C. spp.</u> (unidentified)	I	I	O		I	O	I	I	O
<u>Cymatosira lorenziana</u> Grun.	I	O	C		I	I			
<u>Detonula pumila</u> (Castr.) Schütt				R	R	R	R		I
<u>Dimerogramma marinum</u> (Greg.) Ralfs	R	I	I			I			
<u>D. minor</u> Greg.	I		R					R	I
<u>D. nana</u> Greg.			R			I			
<u>Diploneis weissflogii</u> (A.S.) Cleve	R	I	R	R	I	I			R
<u>Diploneis</u> spp.			I					I	
<u>Ditylum brightwellii</u> (West) Grun.							C	O	I
<u>D. sol</u> Grun.							I		
<u>Eucampia cornuta</u> (Cleve) Grun.	R								
<u>Guinardia flaccida</u> (Castr.) Per.	R			R		R	O	O	R
<u>Gyrosigma beaufortium</u> Hust.			R						

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DIATOMS, cont.	Stations								
	II			III			IV		
	A	B	C	A	B	C	A	B	C
<u>Gyrosigma prolongatum</u> (Wm. Sm.) Cleve									R
<u>Haslea gigantea</u> (Hust.) Sim.	R		?						
<u>Hemiaulus hauckii</u> Grun.	R				R	R	R	R	I
<u>H. membranaceus</u> Cleve				I	C	O		R	
<u>H. sinensis</u> Grev.		R		R	O	I		R	R
<u>Lauderia annulata</u> Cleve				R					
<u>Leptocylindrus danicus</u> Cleve	C	C	C	I					
<u>L. mediterraneus</u> (Per.) Hasle	I	O	O						
<u>L. minimus</u> Gran	R					R			
<u>Lithodesmium undulatum</u> Ehrenb.							I	I	
<u>Mastogloia mediterranea</u> Hust.					R				
<u>Navicula clavata</u> Greg.	R	I							
<u>N. spp.</u>	O	O	O	I	O	I	R	I	I
<u>Nitzschia acuminata</u> Wm. Sm.									R
<u>N. bicaipitata</u> Cleve			R		R				R
<u>N. closterium</u> (Ehrenb.) Wm Sm.	R	I		R			R	R	R
<u>N. constricta</u> (Greg.) Grun.	R	I	C	I	I	R			R
<u>N. cursoria</u> Donk.	R	I	I			R			
<u>N. panduriformis</u> Greg.		R				R			
<u>N. pseudodelicatula</u> Hasle	C	O		I					
<u>N. pungens</u> Grun.	I		R				I	I	I
<u>N. sigmaformis</u> Hust.	I			R	R				
<u>N. subfraudulenta</u> Hasle		I		I	R				
<u>N. spp. (unidentified)</u>	I	I	I	R		R		R	R
<u>Paralia sulcata</u> (Ehrenb.) Cleve	R	C	C	O	O	O	I	R	R
<u>Palmeriana hardmaniana</u> Grev.					R	I			
<u>Plagiogramma leve</u> (Greg.) Ralfs						I			
<u>Pleurosigma sp. cf. angulatum</u> (Quek.) Wm. Sm.		R	R	R					
<u>P. elongatum</u> Wm. Sm.			O			R		I	I
<u>P. naviculaceum</u> Breb.		I	R	R	R	I	R	I	R
<u>P. spp. (unidentified)</u>	I		R	R		I	I	R	
<u>Podosira stelliger</u> (Bail.) Mann	R	O	R	R	R				

[illegible]

	Stations								
	II			III			IV		
	A	B	C	A	B	C	A	B	C
OTHER, concl.									
<u>Potamodiscus kalbei</u> Gerloff		R							
Blue-green alga (coccoïd appearance)	F	A	D	F	F	A		I	
Blue-green alga (filaments)				C	F	C		D	D

These amounts were calculated after counting at least 200 cells (often many more, if chains were involved) from both water mounts and permanent mounts, since some taxonomic groups are apparent in one and not the other.

R = Rare (<1%)

I = Infrequent (1-2%)

O = Occasional (3-4%)

C = Common (5-15%)

F = Frequent (15-30%)

A = Abundant (30-50%)

D = Dominant (>50%)

These abundances reflect the analysis of 35 μ m net hauls.

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V. DISCUSSION

Our interest in the distribution and ecology of the phytoplankton in the Gulf of Mexico stems from the significant role of the phytoplankton as organisms responsible for the fixation of much of the energy utilized by the marine ecosystem. Thus knowledge of the distribution and abundance of these unicellular plant organisms is extremely important in delineating regions of high productivity, such as areas of upwelling, equatorial divergence, river discharge, etc.

It is now generally recognized that slow-moving research vessels (average speed 10 ~ 15 knots), are not very efficient in studying large scale ocean phenomena. In recent years there have been some pioneering studies of remote sensing of marine biological and physical phenomena/parameters using satellites and low-flying aircraft, such as the U-2 used in the present investigation. Of the biological parameters studied by remote sensing, chlorophyll a is the most promising (See Clarke et al., 1970; Szekiolda, 1971; Arvesen, et al., 1971; Szekiolda et al., 1975; El-Sayed and Green, 1974). Surface temperature is the most commonly sensed physical parameters (Harlan and Marlott, 1971; Nordberg et al., 1962; Rao et al., 1971).

The present study thus can be regarded as an extension of the pioneering effort of monitoring ocean phenomena by remote sensing. The results of the present investigation will assume more significance when the data collected by U-2 aircrafts are interpreted in the light of the ground truth data collected by the CALYPSO Cruises and summarized herein. However, to the extend that the U-2 data are still being studied by the NASA scientists we will limit our discussion here to the examination of the data collected during the three legs of the CALYPSO investigation. Where pertinent, we will relate these data to the extensive information on phytoplankton standing crop and nutrient chemistry which we have collected from the Gulf of Mexico during the past 14 years (El-Sayed, 1972).

Leg I

It is clear from the data presented in Figures 2-a through 9-f that, by and large, the various parameters studied, namely: salinity, temperature, depth of euphotic zone, chlorophyll a and nutrient salts, do not show discernible differences between the surface observations made by the CALYPSO and those of the two Zodiacs. With few exceptions, there were no conspicuous variations between the three arrays occupied (i.e., A, B and C).

Factors affecting these variations are: (a) proximity of the observations made to land-masses; (b) proximity to river discharge; (c) topography of the region studied such as the DeSoto Canyon (Station VI) and the Mudhole Station (Station I).

The depths of the euphotic zone clearly reflect the concentrations of the standing crop of phytoplankton. The inverse relationship between the standing crop of phytoplankton and the depth of the euphotic zone reported by several investigators was borne out by the present study.

Leg II

Despite the prominent effect of the Mississippi River discharge on the hydrography and productivity of the north central and northwestern Gulf of Mexico, unfortunately the effect of this discharge has not been studied in sufficient detail. The present investigation has afforded us an excellent opportunity to contribute to our knowledge of the effect of the Mississippi discharge on the phytoplankton standing crop, nutrient concentrations and light penetration. Thus from the data collected during this leg, we note the following: (a) the relatively high productivity off the Mississippi Delta and its environs is due to the discharge of the Mississippi River. However, our study shows that the

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Mississippi discharge has only local effects on the productivity of the Gulf as a whole. Riley (1937) data show that the effect of the Mississippi River (in terms of phosphate content) is hardly felt beyond an 80 km radius of the mouth of the river.

Leg III

Unlike the stations of Legs I and II which were occupied in shallow coastal waters (mostly on the continental shelf), those occupied in Leg III (except for Station X) were in deep-oceanic waters. The data from the nine stations occupied across the Yucatan and the Florida Straits show close similarities in the vertical distributions of temperature and salinity. Station X, occupied off the northeastern tip of the Yucatan Peninsula, showed the 'land-mass effect' by its relatively high chlorophyll *a* values, increased phosphate concentrations and the shallowness of its euphotic zone. The richness of this station as well as others occupied in this leg could perhaps be due to the effect of the nutrient-rich deep water flowing from the Caribbean over the sill in the Yucatan Channel, thus contributing to the high productivity of the Campeche Bank.

The vertical distribution of phosphates at the stations occupied during this leg of the cruise shows only the uppermost segment of their distributions. El-Sayed (1972) has noted that in the Gulf of Mexico the vertical distribution of phosphates, silicates and nitrates follow more or less the following pattern: (a) very low values between the surface and 100 - 200 m; (b) substantial increase between 200 and 700 - 800 m; (c) maximum values at about 1000 m and (d) small decreases in concentrations below 1,000 m. Thus in view of the shallowness of the hydrocasts made at during Leg III, one only gets an incomplete picture of nutrient distribution of the Gulf of Mexico and the Caribbean Sea.

The vertical distribution of chlorophyll a in the water columns studied showed uniformly low values at or near the surface, these were followed by peaks of abundance between 50 and 100 m (e.g. Station XVIII), and then by gradual decrease thereafter. Secondary peaks were also encountered; these were associated, in some cases, with the positions of the thermoclines, and possibly the nutriclines. (See Fig. 27).

It is interesting to note that in many of the figures depicting the vertical distribution of chlorophyll a, substantial amounts of chlorophyll were found below the depth of the euphotic zone. The data from the present investigation corroborate earlier findings by El-Sayed (1972) who reported chlorophyll a values at depths of 200 m, with concentrations occasionally higher at this depth than at the surface.

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VI. SUMMARY AND CONCLUSIONS

The present investigation was directed toward a study of the distribution and concentrations of the standing crop of phytoplankton, and nutrient salts in the Gulf of Mexico and to correlate their distributions with the physical and chemical parameters studied. The investigation was specifically designed to provide basic scientific information for correlating temperature and chlorophyll a measurements in the Gulf of Mexico with observations from NASA U-2 aircraft equipped with specially designed instruments for the measurements of ocean color phenomena.

A summary of the results obtained during this investigation is given below:

- (1) At Stations II, III and IV (Leg I), where the U-2 flights were made, the surface truth data do not show discernible differences between the observations made by the CALYPSO and the two Zodiacs.
- (2) Only on a few occasions we did find conspicuous variations between the three Arrays (i.e. A, B and C) studied during Leg I. The factors contributing to these variations are: (a) proximity of the observations made to land masses, (b) proximity to river discharge and (c) topography of the region studied.
- (3) The depths of the euphotic zone reflected the concentrations of the standing crop of phytoplankton; the depth of the former is inversely proportional to the concentrations of the latter.
- (4) The relatively high productivity off the Mississippi Delta and its environs is due to the river discharge; however, the effect of this discharge is only local.

- (5) The distribution of the temperature, salinity, chlorophyll, and nutrients during Leg III is what one normally expects in deep-oceanic, subtropical waters.
- (6) There was a marked contrast in the standing crop, nutrients and light penetrations between inshore and offshore waters, with the former more productive, nutrient-rich, and with a shallower euphotic zone.
- (7) A total of 154 species of phytoplankton were identified at Station II, III and IV of Leg I. The highest number of species at a single station was 66 at Station III-C, and the lowest was 54 at Stations IV-A and IV-B.
- (8) The blue-green algae were dominant at Stations II-C, IV-B and IV-C, and abundant at Station II-B and III-C.
- (9) Dinoflagellates occurred in small numbers, being rare in most of the samples studied.
- (10) Phytoplankton samples, in general, were noted for the large number of species present in small populations, and the mixture of truly planktonic and benthic forms.

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PART II

REMOTE SENSING INVESTIGATIONS OF THE GULF OF MEXICO
AND CARRIBEAN SEA DURING THE 1974-75 R/V CALYPSO CRUISE

by

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The Remote Sensing Center, Texas A&M University

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1.0 Introduction

Part I of this report has dealt with the biological, chemical and physical data. Part II will be concerned with correlative studies between the data of Part I and various remote sensing observations. The joint oceanographic-remote sensing research program was recently conducted aboard the R/V Calypso in conjunction with NASA/GSFC, EPA/EPIC, NOAA/NESS, the Cousteau Society, and Texas A&M University. The cruise began in early October, 1974 and terminated in late February, 1975. The cruise consisted of 3 Legs in the Gulf of Mexico and in the Carribean Sea. Leg I was conducted from Key West, Florida to Pensacola, Florida and was overflown at three stations by the NASA/U-2 borne ten channel Ocean Color Scanner (OCS). Leg II consisted of a detailed study of the effects of the South West Pass plume of the Mississippi River upon the Gulf of Mexico and Leg III was a study of the currents of the Yucatan and Florida Straits.

The experiments were designed to provide basic scientific information for correlating surface truth measurements of the ocean with airborne observations from the OCS, the NOAA III satellite, and later LANDSAT. The ship was also equipped with a prototype $2^\circ/90^\circ$ scattering meter, designed by Dr. McCluney of NASA/GSFC to detect organic and inorganic particulate concentrations. Other continuous in-situ and

remote sensing equipment included a PRT-5 infrared radio-mater and two flow-through fluorometers. The sampling program onboard the CALYPSO consisted of: (a) regular hydrocasts using 5-litre Niskin samplers; (b) secchi disc readings; (c) bucket temperature readings; (d) XBT profiles; (e) 20 m vertical plankton tows; (f) and transparency readings from a submersible transmissometer. In addition, data on physical conditions included local weather conditions, sea state, wind velocity, barometric pressure, relative humidity, and positions of the CALYPSO and Zodiacs. Zodiacs were utilized to form a surface sampling grid that covered approximately 27 sites in approximately 115.0 square kilometers (80 square miles). Communication equipment included the APT and ATS satellite systems.

During the course of the cruise, additional and previously unexpected experiments were conducted. LANDSAT imagery was utilized over the Mississippi Plume for an extensive Mississippi Plume Study, a study of the Yucatan and Florida Straits was conducted, and different uses for the APT/ATS systems were applied.

The Interim Report on this project was submitted approximately one month after the conclusion of the cruise and consisted of data that could be rapidly analyzed. This report included a description of the methods and materials, all raw transmissometer data, raw scattering meter data, a

rough PRT-5 data summary, complete log summaries, a summary of the LANDSAT "Quick Look" Experiment, and the complete biological, physical, and chemical data from the U-2 over-flight stations as analyzed by El-Sayed and El-Reheim.

As observed in Part 1 of this report the physical, chemical, and biological data has been nearly completed by the Oceanography Department personnel. Remote Sensing Center personnel helped in some aspects of that work. While these data were being analyzed, Babai and Hill spent three weeks at GSFC in an effort to complete the scattering meter data, transmissometer data, and to observe and help with the preliminary OCS data analysis. The following report completes the preliminary analysis of data from the entire cruise and derives various general conclusions on the related cruise data. Several publications are expected to evolve from these results. A paper entitled "Flow-Through De-Bubbler for Shipboard Use" is presently being submitted to related journals. A joint NASA/TAMU paper entitled "LANDSAT Digital Data Processing, a Real-Time Application" was recently presented at the NASA/Earth Resources Survey Symposium, June 10, 1975. A third paper entitled "A Biological and Physical Oceanographic Remote Sensing Study Aboard the CALYPSO" has been presented at the Tenth International Symposium on Remote Sensing of Environment in October 1975. A presentation was also given at the Sea Grant sponsored Third Annual Student Conference on Marine

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Affairs and was entitled "Life and Science Aboard Jacques Cousteau's R/V CALYPSO."

If additional funds can be obtained, the following is an outline of our expected course of continued data analysis.

Task A This task would be to further analyze the data collected during this cruise. This report does not include an extensive statistical correlation of related physical, chemical, and biological oceanographic parameters.

- (1) Analysis of continuous fluorometric data to be compared to related biological, physical, and chemical data; also included will be a comparison of the two fluorometers utilized during the cruise
- (2) PRT-5 data analysis
 - (a) Characterize data acquisition environmental conditions as rainy, cloudy, sunny, smooth, rough, etc.
 - (b) Statistically compare bucket temperatures to PRT-5 data
 - (c) Overlay PRT-5 data onto OCS and NOAA III imagery
 - (d) Compare PRT-5 data to biological, physical, and chemical data newly available and described in Section 1
- (3) Scattering Meter data analysis
 - (a) Statistically compare to all relevant data

- (b) Continuous data is to be reviewed
- (c) Compare it to newly acquired biological, physical, and chemical data from Section 1
- (4) Compare surface data to those from the water column at different depths
- (5) Statistically analyze related parameters to extinction coefficients
- (6) Compare continuous measurements of scattering meter, fluorometer, and PRT-5

Task B This task would include the correlation of existing surface truth oceanographic data with NOAA 3 and 4 VHRR infrared and visible imagery and LANDSAT imagery.

- (a) Acquire imagery and CCT's collected by other users over the areas of interest
- (b) Obtain grey scale printouts and contours of the imagery through processing steps described later in Section 2
- (c) Overlay Calypso sampling grid and continuous data on contoured images
- (d) Overlay biological, chemical, and physical data

Task C Work conducted on the OCS data revealed that various relations can be observed about certain marine parameters from at least one OCS flight. Two cloud free

flights were flown and correlative studies including the results from Task A will be conducted on both U-2 overflights.

- (a) Examine the six bands previously not digitized by GSFC
- (b) Further examine Timbalier Bay area data
- (c) Compare OCS imagery to NOAA III imagery
- (d) Compare to recently acquired continuous data including new biological, chemical, and physical data

Task D Conduct an extensive Mississippi Plume Study analysis from the results of Task A and Task B.

Task E Future U-2 flown OCS flights over areas of upwelling are planned to determine the quantitative measurement capabilities of the instrument before its use on NIMBUS G in 1978. We feel that, with our present experience in working with the OCS data, a funded extension to our present NASA contract allowing us to work with future OCS flights would greatly enhance the capabilities of such an instrument as well as NASA's oceanographic interests.

Task F Publish, by journal articles and a Ph.D. dissertation, the results of the analyses listed above tasks.

2.0 OCEAN COLOR SCANNER DATA SUMMARY

The Ocean Color Scanner (OCS) was developed by Dr. Warren Hovis, NASA/GSFC, and a breadboard model was flown on a NASA U-2 aircraft in preparation for the instrument's eventual use on NIMBUS G in 1978. The OCS is a ten channel scanner which has a 90° total scan angle, which provides a useful swath width of about 15 miles, and a spatial resolution of approximately 3.5 milliradians.

The peak wavelengths, with average band widths of 26 nanometers, are:

Band 1 - 427	Band 6 - 622
Band 2 - 465	Band 7 - 662
Band 3 - 500	Band 8 - 701
Band 4 - 544	Band 9 - 735
Band 5 - 582	Band 10 - 774

The scanner data is recorded in analog form on one inch, 14 track magnetic tape. At the time of this study, four of the ten channels could be recorded in digital form. The contrast of the OCS imagery is quite good for the instrument is equipped with high gains and uses offset or bias voltages. The full dynamic range of the detection and recording electronics can then be applied only to the small variations in

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signal that are superimposed on the upwelling path radiance produced by the atmospheric scattering (McCluney, 1975).

Four Vinten cameras were also flown onboard the U-2, three of which carried black and white (Panatomic-X) film and one carried standard color aerial film. The U-2 flew at a height of 19.8 kilometers (65,000 ft.) and a speed of 390 knots (219.7 m/sec).

An investigation of the U-2 flown OCS data had been started almost immediately after the data had been received at GSFC, through the use of a "quick-look" technique, by Hovis and Lung. Three flights on three different days had been flown over the rather elaborate sampling grid (Harlan, et al., 1975) laid out by the scientists and crew of the R/V CALYPSO. The flights occurred on November 10, 13, and 15, and were numbered Flights 15, 16, and 17. The "quick-look" black and white imagery was observed to obtain a useful test area for correlative studies. Flight 15, unfortunately, was found to be cloud covered in the area of sampling. Flight 17 was over the Timbalier Bay area of Louisiana where the waters were relatively homogeneous. Flight 16, which was flown over the Panama City, Florida waters did contain observable water boundaries between various water masses. This area was chosen for various correlative studies between the surface measurements and the OCS radiance data.

Upon observing the U-2 imagery, it was discovered that the scanner had been turned on after it had left land and was turned off before it reached the shoreline. To add to these difficulties, the time tick device was not in operation during this particular flight sequence. This necessitated the plotting and horizontal shifting of the surface truth sampling grid over a grey scale map of the general area of interest. That is to say that a grey scale map of the U-2 imagery had to be plotted to show the various water patterns that the OCS viewed. The position of the U-2 was known on the grey scale maps, for it was the U-2 that originally took the imagery. The CALYPSO could not be seen on any of the images, but the extensive sampling grid could be overlayed and shifted around on the grey scale map in order to match up the patterns on each. The two in fact matched up fairly well as the graphs later in this paper will demonstrate.

Much interest has been paid to the relationship of ocean water color to such related parameters as chlorophyll concentrations, zooplankton, silt, and sediments. Chlorophyll is one of the main interests in ocean color studies for chlorophyll bearing organisms are the base of the ocean's food chain. Areas high in phytoplankton

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are often high in fish yields. The reports of Atkins and Poole (1958) and Yentsch and Rytha (1959) indicated the importance of the blue regions of the spectrum to the chlorophyll bearing organisms, the phytoplankton. Yentsch (1959, 1962, 1971) has demonstrated that living phytoplankton have strong absorption bands from 440 to 450 nanometers and at 670 nanometers. Clark, Ewing and Lorenzen (1970) demonstrated that chlorophyll concentrations ranging from 0.3 to 3.0 mg/m³ could be detected with spectroscopic measurements made from 400 to 700 nanometers.

In areas of upwelling and river outflows into marine environments, sediments are present with higher levels of chlorophyll. Secchi measurements have also been utilized in these correlative studies. Kalle's (1937, 1938, 1939) and Jerlov's (1951a, 1951b, 1953) findings indicate that in coastal waters the spectral change from blue to green is the result of selective absorption by the gelbstoffe (yellow material) in the water. Yentsch (1959) showed a relationship between the salinity and yellow material, especially near fresh water river plumes entering a marine environment. This work was conducted from aircraft at relatively low altitudes which provided only small

areas of coverage. Higher altitude studies, while providing a larger synoptic view of the oceans do put more atmosphere between the sensor and the sea, therefore enhancing the problems of the effect of the atmospheric backscatter on such measurements.

Hovis (1973) suggests that information concerning chlorophyll might best be arrived at from radiometric data by ratio techniques instead of single wavelength measurements. This is because the absorption at 550-600 nm is relatively independent of chlorophyll and could be the normalizing factor. Arvesen (1971) also utilized two wavelengths in correlative differential radiometry studies to detect variations in chlorophyll concentrations. Ratios of different wavelengths appear to be the key to the detection of chlorophyll concentrations.

For data reported here, a grey scale map was first plotted using the blue over the green ratios. The boundaries were not well delineated and it was concluded that the blue detector isn't in actuality very sensitive to the blue in the water. The problem is that with a scanner at very high altitudes (65,000 ft. in this case), the atmospheric scattering due to particles in the atmosphere play havoc with the ocean color imagery.

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Ratios were also used to eliminate the systematic distortions of the scanner data. The red band (622 nm), in the chlorophyll absorption band, was the numerator. The green band (544 nm) was used as the denominator since the chlorophyll doesn't absorb the green light and the green is therefore not sensitive to the chlorophyll levels.

Lung used the following formula to obtain the computed C7/C4 ratio:

$$\frac{C7}{C4} = 1.95 + \frac{1}{7.5 + \text{chlorophyll (mg/m}^3\text{)}}$$

By comparing the pattern of the measured C7/C4 vs. that of the measured chlorophyll, we assumed that the boat could be located on the grey scale map. Lung then went back and derived the computed C7/C4 using the function. The pattern of the C7/C4 values was then used to help find the location of the boat by comparison to the radiance levels.

The following graphs are a presentation of each separate CALYPSO/Zodiac sampling station (A, B, and C for the Panama City Test area) and the U-2 data taken from the OCS. The bottom graph depicts the secchi measurements collected from the CALYPSO and Zodiacs. The middle graph is the

plotted measured C7/C4 from the ratio of C7 values to those of C4. These ratios have been smoothed by averaging the three radiance values that bracketed the CALYPSO or Zodiac sampling positions. It must be remembered that this data was originally plotted with the radiance ratios on one graph and later overlayed on the surface truth data grid and shifted horizontally to obtain the best correlations between the U-2 imagery and the surface truth.

The first graph (Figure 1) is of Station A. The ratio of red/green (measured ratio) seems to vary significantly with variations in the measured secchi samples. The computed C7/C4 (from the measured chlorophyll) has a similar curve, but appears to be shifted to the left.

The second graph (Figure 2) of Station B, is a different case. The measured secchi depths do not correlate as readily with the ratio as our first station had done. The computed curve of C7/C4 also does not readily correlate with the measured radiances from the scanner.

The graph (Figure 3) of Station C tends to demonstrate a correlation between the secchi measurements and the radiance ratios. The computed C7/C4 also shows promising correlations with the measured radiance levels.

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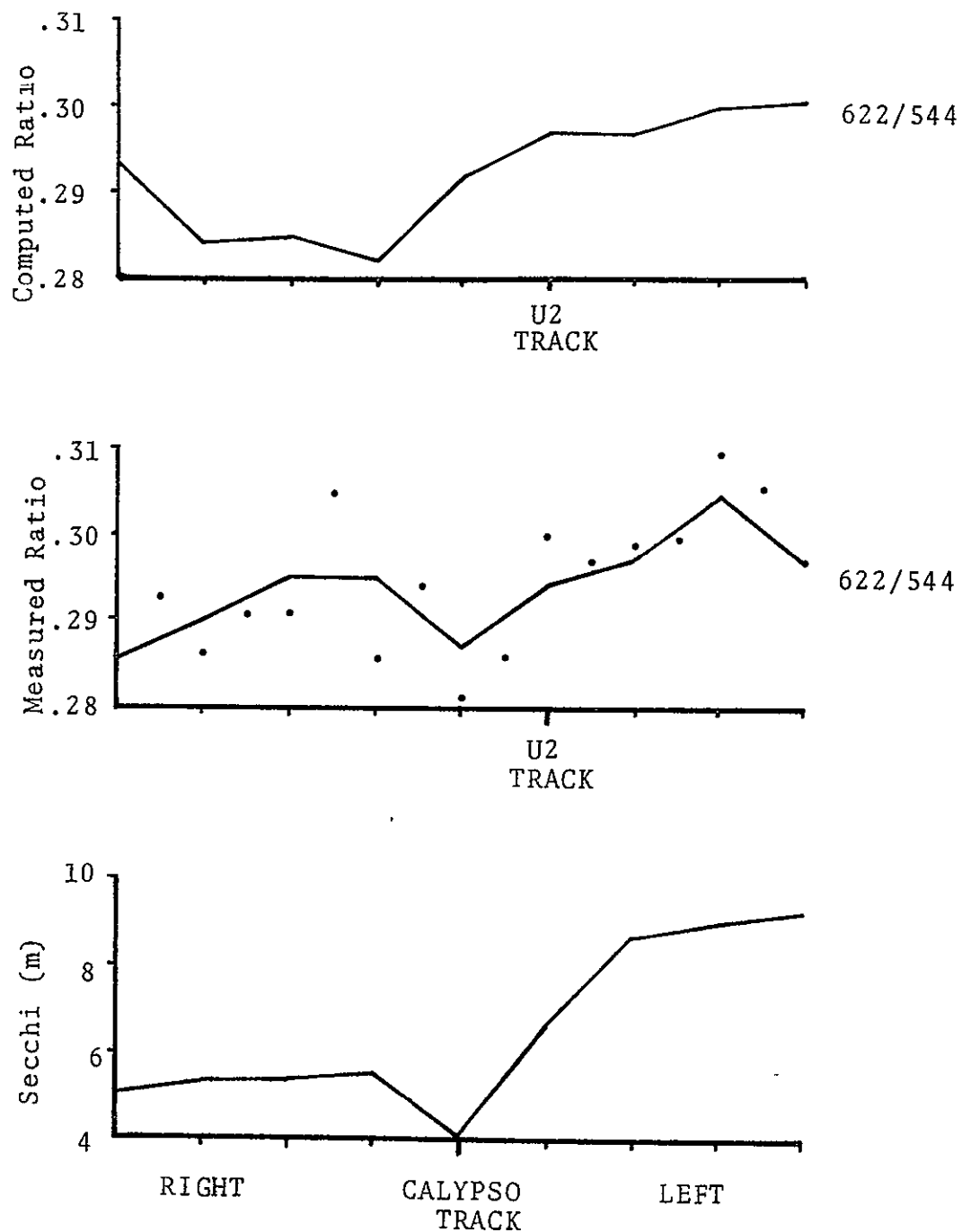


Figure 1 U-2 Measured Ratio (622/544), CALYPSO Secchi and Computed Ratio (622/544) Data for the Panama City Area, Site III A

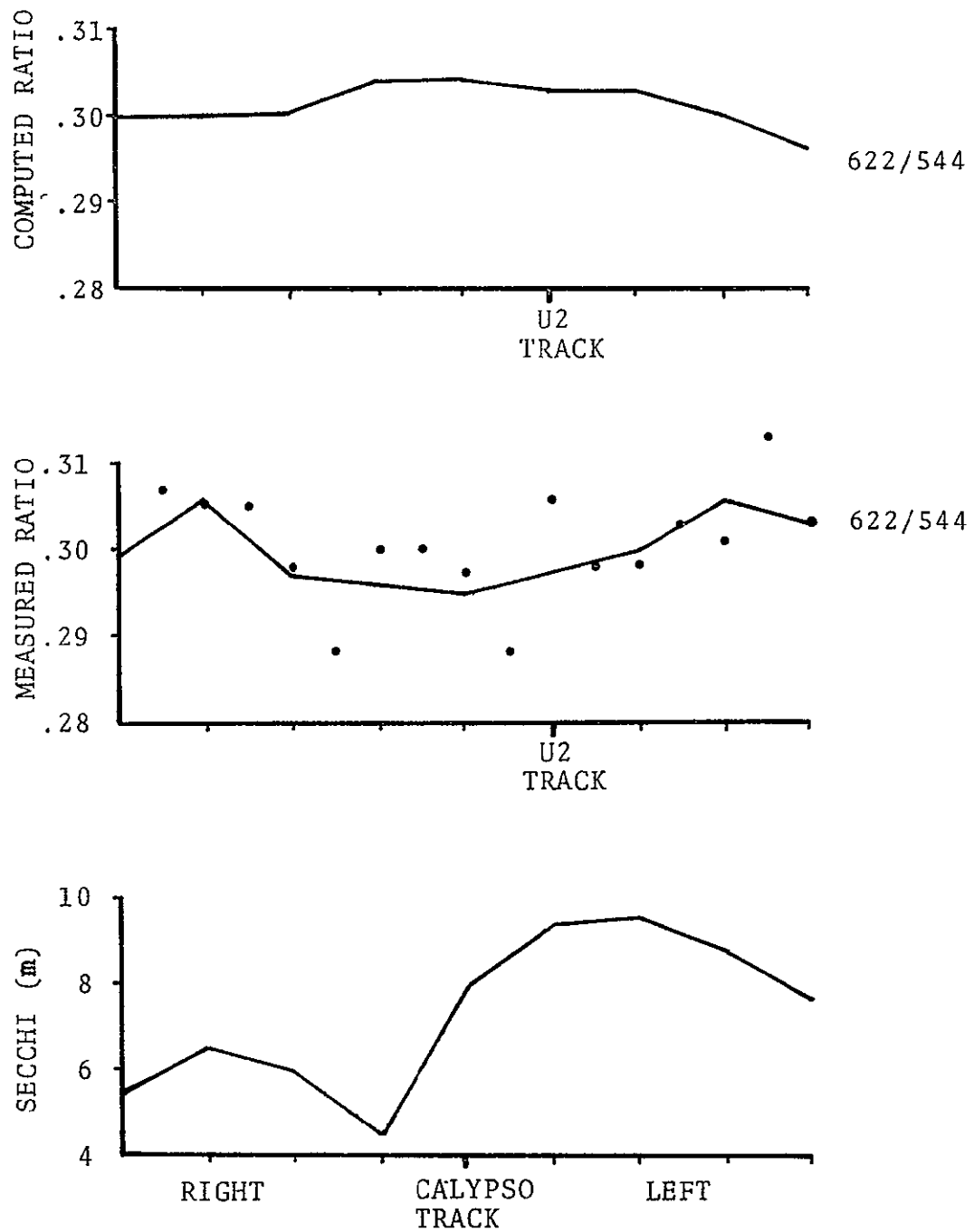


Figure 2 U-2 Measured Ratio (622/544), CALYPSO Secchi and Computed Ratio (622/544) Data for the Panama City Area, Site III B

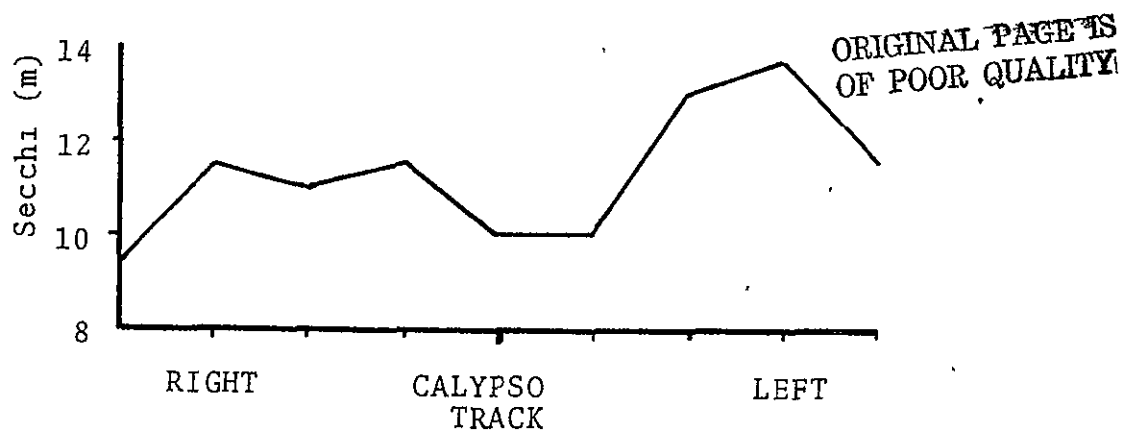
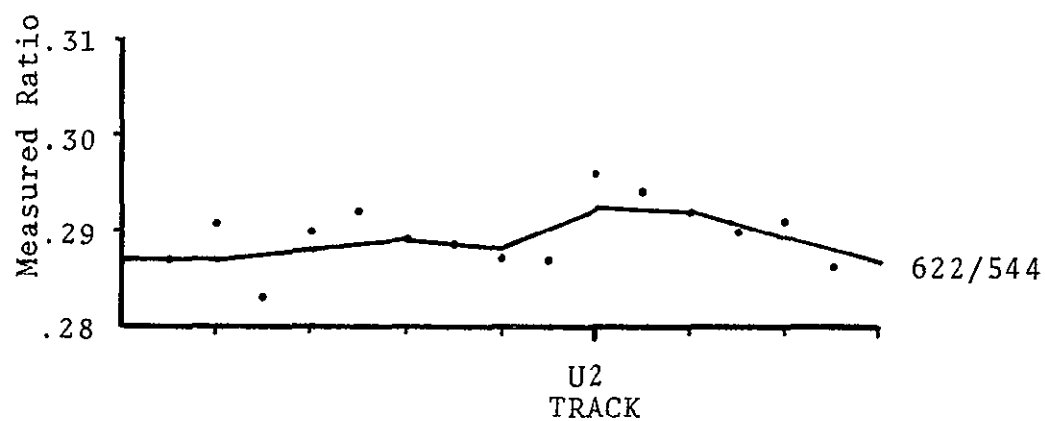
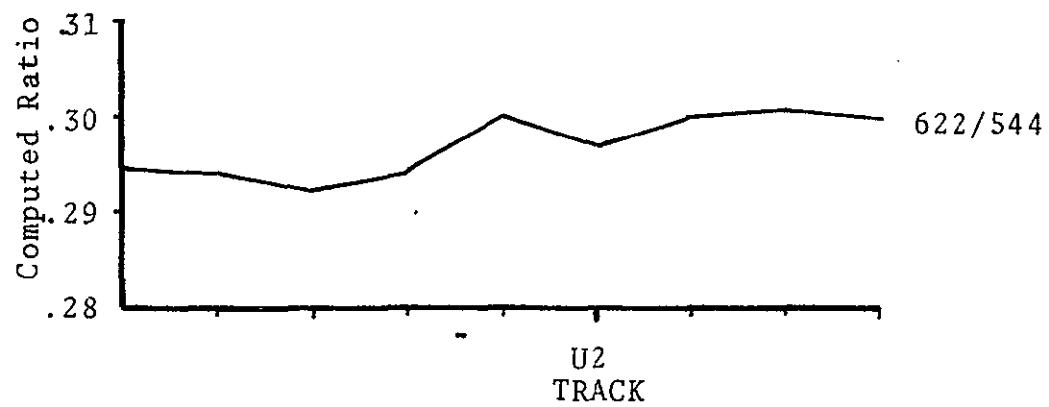


Figure 3 U-2 Measured Ratio (622/544), CALYPSO Secchi and Computed Ratio (622/544) Data for the Panama City Area, Site III-C.

These curves give promising evidence that good correlation exists between certain selected radiance ratios and chlorophyll concentrations. Secchi measurements related to the amount of material present in the water column also could be correlated to the individual radiance levels or the ratio of the red to green bands. The feasibility of using the scanner to depict various gradient levels has been shown to be possible, but the OCS must be flown over more highly productive, possibly upwelling, areas to prove its quantitative accuracy.

3.0 TRANSMISSOMETER DATA SUMMARY FOR LEGS I, II, AND III

Appendix A is a list of the Transmissometer measurements with depth at each station for Legs I, II, and III. This is an expanded list compared to that provided in the Interim Report. Included are not only the percent transmittance but also the associated light extinction coefficient, total chlorophyll and salinity measurements. The chlorophyll and salinity values are transposed from Section I for the ease of the reader. A one meter path length was used for every transmittance reading throughout the entire cruise.

Since only one chlorophyll and one salinity measurement were collected from each depth, due to time limitations, the same chlorophyll and salinity data were associated with the appropriate depth reading of the transmissometer, both on its way down and on its way up. The chlorophylls, as noted, were added together exempting the fact that a, b, and c do have overlapping spectral absorption bands to some extent and that some error is introduced by not accounting for that overlap.

The extinction coefficients, salinity, and total chlorophylls are illustrated for Leg II, The Mississippi Plume Study, in Figure 4. These data were correlated to

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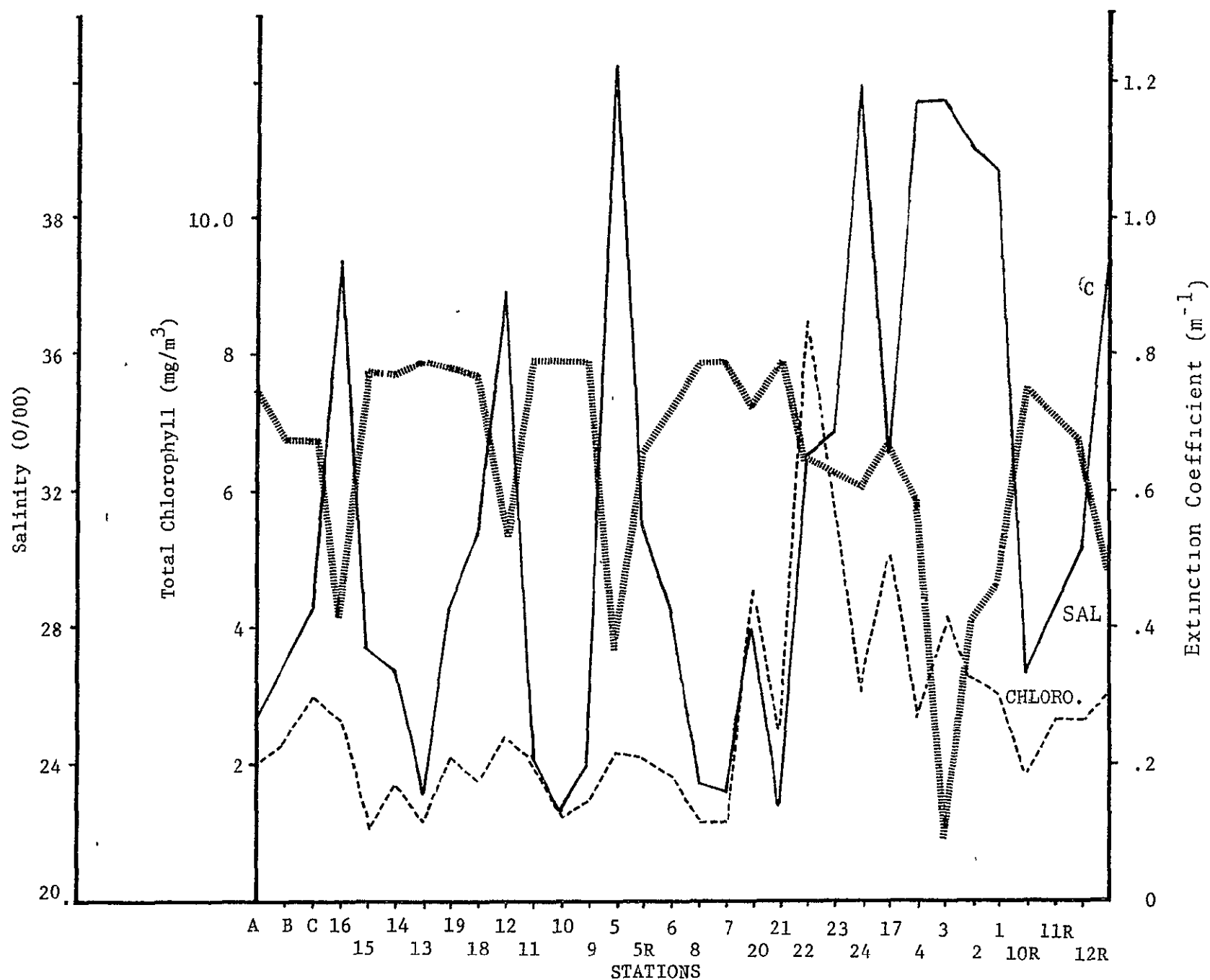


Fig. 4. Salinity, Total Chlorophyll, and Extinction Coefficients for Leg II

(1) see if various related independent measurements were in fact consistent with one another and (2) to see if the expected correlation did in fact exist for later comparison studies with the U-2 and satellite imagery.

For the plume study, this graph indicates that when there is a rise in salinity, the total chlorophyll concentration and the extinction coefficient tend to decrease. This would first indicate that the more saline waters are less productive than the nutrient laden fresh water masses coming out of the Mississippi River. There also appears to be an inverse relationship between salinity and the extinction coefficient. This relationship points out the fact that the fresh river water also carries the most sediments. If the extinction coefficient is relatively high, then the water being sampled is highly turbid. When the total chlorophyll increases the extinction coefficient generally increases showing that organic (and inorganic, although not sampled) particles effect this inverse relationship between particles in the water column and the light extinction coefficient.

It was then decided to compare the relationship between the light extinction coefficient and the depth of the euphotic zone, which is computed through the use of the secchi measurements (Figure 5). Again as suspected, it

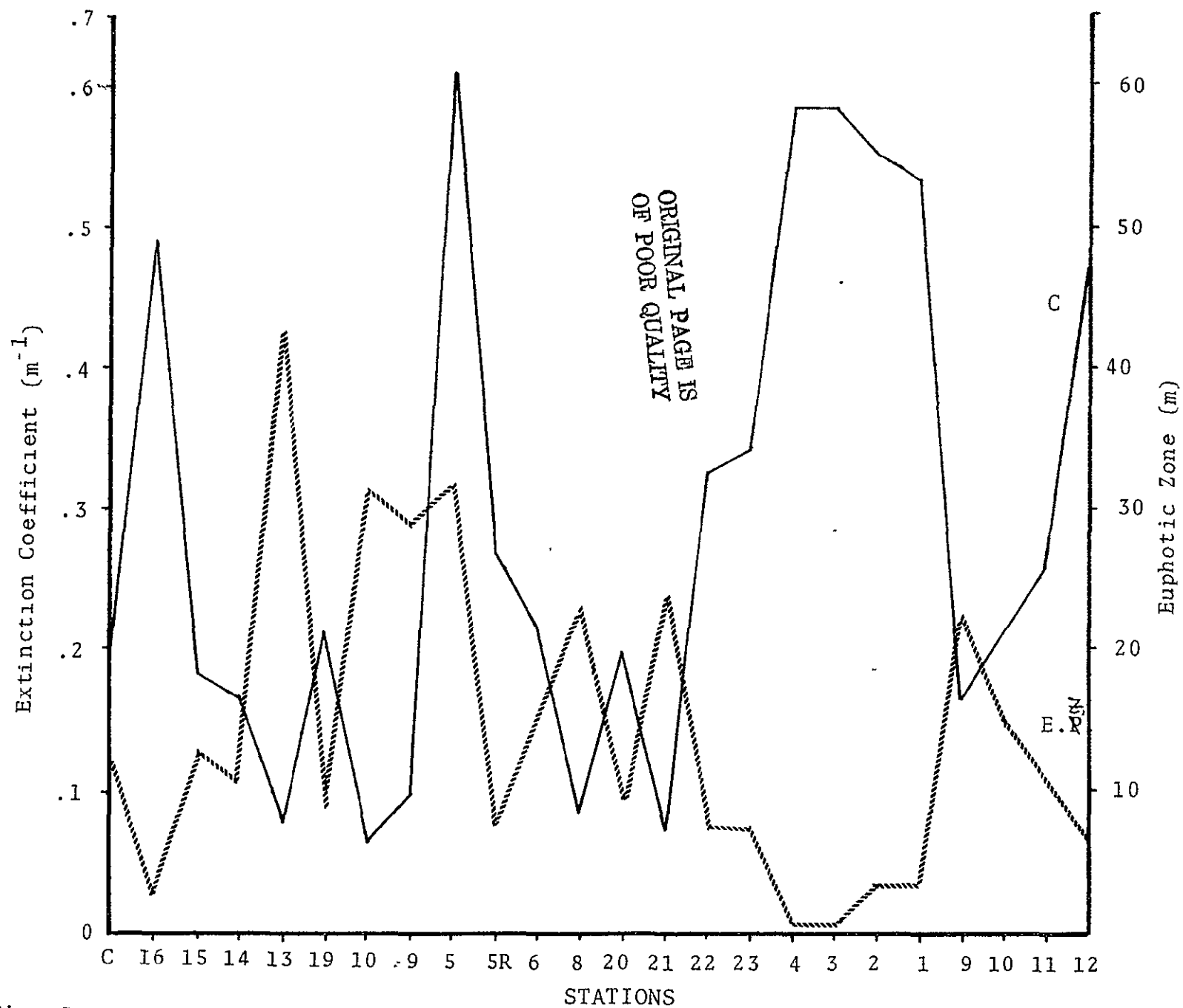


Fig. 5. Selected Extinction Coefficient and Euphotic Zone Measurements for Leg II

appeared that an inverse relationship existed between the depth of the euphotic zone (or the secchi measurements) and the extinction coefficient. These measurements further verified the transmittance readings.

Lastly, the total chlorophyll and surface bucket temperature readings were compared. Arvesen, Millard, and Weaver (1971) believe that water temperature is a possible correlative measurement of chlorophyll, for certain processes contributing to phytoplankton growth also appear as temperature changes. They utilized an infrared radiometer to detect temperature changes and a differential radiometer to detect chlorophyll concentrations. They found that almost every variation in chlorophyll along the flight path was associated with an inverse variation in temperature. This variation may possibly involve the vertical migration of organisms with changes in sea surface temperatures. Blackburn (1969) found similar correlations in Pacific coastal waters between fish, surface chlorophyll, and temperature.

The data from Leg II (Figure 6) also indicated that when surface temperatures increased, the total chlorophyll concentration in the upper layer decreased. There was, in general, an inverse relationship between total surface chlorophyll concentrations and sea surface temperature.

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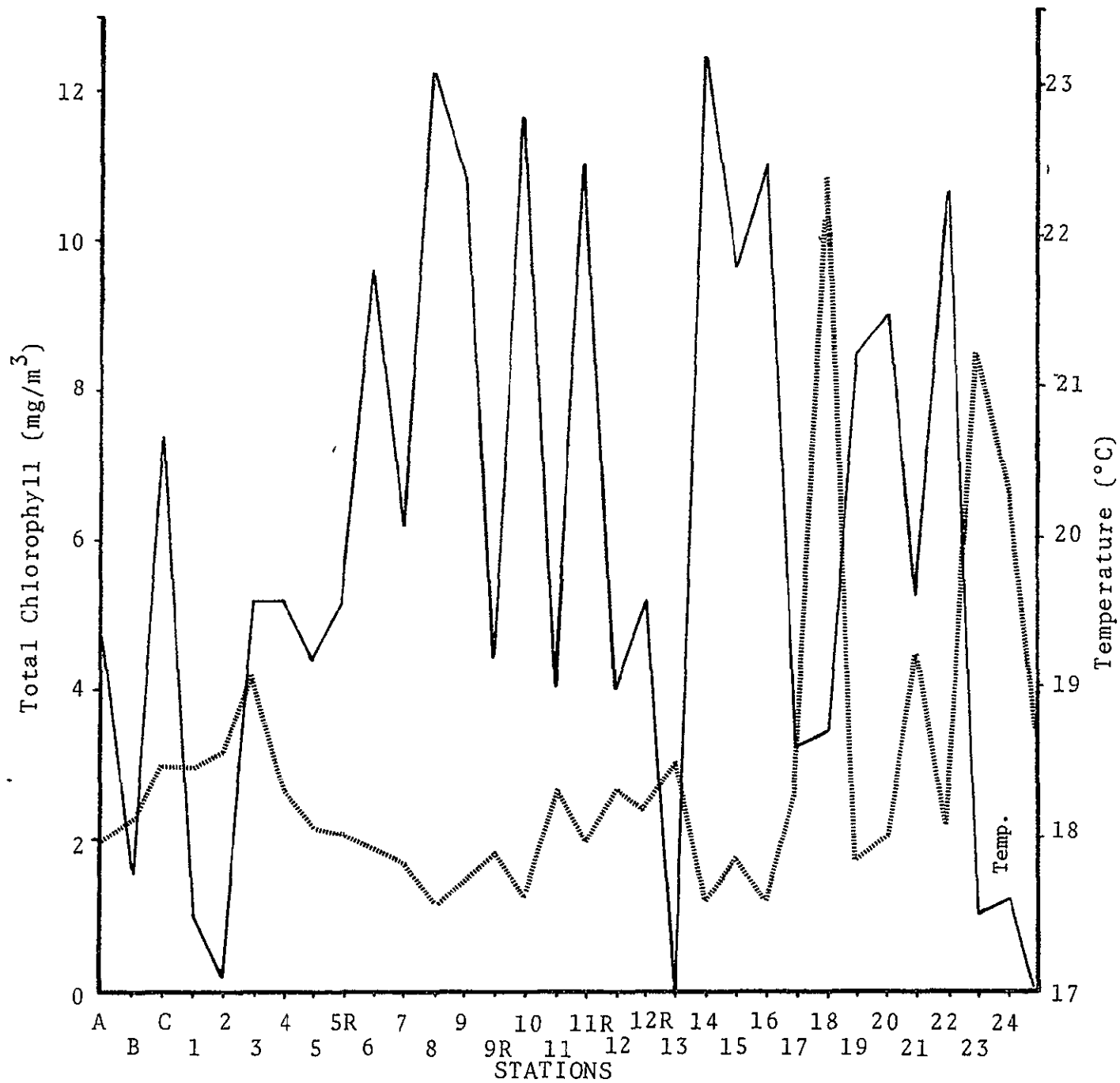


Fig. 6. Total Chlorophyll and Temperature Measurements for Leg II

4.0 SCATTERING METER DATA SUMMARY FOR LEGS II AND III

This section consists of conclusions derived from the scattering meter data obtained from Leg II after the New Orleans stop over and Leg III. The scattering meter tables (Appendix B) are expanded over those in the interim report, which included SIG (2), SIG (90), Transmittance (TR), and S (SIG). The percent transmittance, extinction coefficients and euphotic zones have been added to these tables where such readings had been acquired by the CALYPSO. These three readings, unlike the scattering meter data, were not continuous. The euphotic zone data was computed from the secchi disc data by Dr. El-Sayed's technicians. The VSF (2), VSF (90) and extinction coefficient calculations were added to the graphs during the visit to GSFC. The necessary algorithms were supplied by Dr. McCluney.

There are some reservations that must be mentioned at this point on the operation of the scattering meter. During Leg I there appeared to be a problem with the gain controls. The instrument was sent to GSFC for calibration from Pensacola, Florida and was returned to the ship in the middle of Leg II during the stop in New Orleans. The instrument was left onboard at the end of Leg II for a

period of about two months. The laser appeared to be operating at approximately half its original power during Leg III. Upon observations once the instrument arrived at GSFC, the source of the laser was found to be quite low and the electrical system of the scattering meter appeared to have internal malfunctions. Voltages on the CALYPSO were unregulated, but did not vary considerably with time.

Tables 1 and 2 contain the predicted values from the $\beta 2^\circ$ and $\beta 90^\circ$ readings from the scattering meter of the organic mass (OM), the inorganic mass (IM), the particulate mass (PM), the ratio of OM to IM, the organic volume (OV), the inorganic volume (IV), the particulate volume (PV), and the ratio of OV to IV. The algorithms for these predicted values were also provided by McCluney/GSFC. Also listed are the total surface chlorophyll measurements collected by the CALYPSO. If scattering meter data was taken two or three times at any one station, the same chlorophyll measurements were used for each, since only one chlorophyll sample was taken at each station. The chlorophyll data was transposed from Part I of this report for NASA's convenience in viewing any possible correlations between chlorophyll concentrations and 2° scattering data.

The VSF (2), VSF (90) total chlorophyll and extinction coefficients are plotted on Figure 7. The 90°

TABLE 1
PREDICTED ORGANIC AND INORGANIC PARTICULATE CONCENTRATIONS FOR EXPERIMENTALLY MEASURED
TOTAL CHLOROPHYLLS FOR SELECTED SAMPLES FROM LEG II (AFTER NEW ORLEANS)

Station Number	$\beta(2)$	$\beta(90)$	OM	IM	PM	OM/IM	OV	IV	PV	OV/IV	Total Chlorophylls (mg/m ³)		
											a	b	c
21	13.4	.004	2.09	0.52	2.61	4.00	1.90	0.18	2.08	10.66	0.593	0.205	1.456
21	15.6	.006-.012	1.66-1.77	.82-1.76	2.48-3.53	2.03-1.00	1.51-1.60	.28-.60	1.79-2.21	5.41-2.67	0.593	0.205	1.456
22	34.0	.049	16.91	7.44	24.34	2.27	15.37	2.54	17.91	6.06	3.973	0.717	3.748
22	45.0	.088	35.61	13.48	49.09	2.64	32.37	4.60	36.97	7.03	3.973	0.717	3.748
23	35.0	.067	26.87	10.26	37.13	2.62	24.42	3.50	27.93	6.97	6.603	4.198	0.082
23	42.8	.069	25.46	10.51	35.98	2.42	23.15	3.59	26.74	6.45	6.603	4.198	0.082
24	51.4	.133-.138	59.24-62.09	20.51-21.30	79.75-83.39	2.89-2.92	53.85-56.45	7.00-7.27	60.85-63.72	7.69-7.76	1.951	0.158	1.042
4	182.0	.840	420.69	130.71	551.40	3.22	382.45	44.61	427.06	8.57	1.088	0.402	1.196
3	301.0	1.64	839.09	255.63	1094.72	3.28	762.81	87.25	850.05	8.74	1.388	0.605	2.168
3	210.0	1.53	805.93	239.05	1044.98	3.37	732.66	81.59	814.25	8.98	1.388	0.605	2.168
2	170.0	.349	143.97	53.55	197.52	2.69	130.88	18.28	149.16	7.16	1.319	0.271	1.653
1	155.0	.192	59.13	28.96	88.10	2.04	53.76	9.89	63.64	5.44	1.319	0.293	1.378
9R	232.0	.048	48.31	5.69	54.00	8.49	43.92	1.94	45.86	22.62	0.871	0.348	0.627
9R	219.0	.041	48.07	4.69	52.76	10.25	43.70	1.60	45.30	27.29	0.871	0.348	0.627
10R	248.0	.090	29.53	12.17	41.70	2.43	26.85	4.15	31.00	6.46	1.095	0.299	1.277
11R	240.0	.051	49.21	6.10	55.30	8.07	44.74	2.08	46.82	21.50	1.101	0.195	1.359

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TABLE 2
PREDICTED ORGANIC AND INORGANIC PARTICULATE CONCENTRATIONS AND EXPERIMENTALLY MEASURED
TOTAL CHLOROPHYLLS FOR SELECTED SAMPLES FROM LEG III

Station Number	$\beta(2)$	$\beta(90)$	OM	IM	PM	OM/IM	OV	IV	PV	OV/IV	Total Chlorophylls (mg/m ³)		
											a	b	c
X	456.62	.003	147.37	3.20	150.57	46.08	133.97	1.09	135.06	122.74	0.746	0.407	1.692
X	332.23	.005-.006	103.61-105.04	1.88-1.73	107.50-106.77	56.07-60.85	96.01-95.49	.64-.59	96.65-96.08	149.35-162.09	0.746	0.407	1.692
XI	847.46	.002	275.55	6.50	282.04	42.41	250.50	2.22	252.71	112.97	0.536	0.249	1.204
XI	564.95	.001	183.88	4.38	108.26	41.95	167.16	1.50	168.66	111.74	0.536	0.249	1.204
XII	10.05	.000	3.28	.08	3.36	40.62	2.98	.03	3.01	108.20	0.376	0.152	0.887
XII	9.55	.001	2.55	.08	2.63	31.60	2.31	.03	2.34	84.17	0.376	0.152	0.887
XIII	38.14	.030	4.69	4.41	9.11	1.06	4.27	1.51	5.77	2.83	0.377	0.174	0.612
XIII	11.58	.005	.92	.69	1.62	1.33	.84	.24	1.08	3.54	0.377	0.174	0.612
XIII	15.75	.006	1.71	.82	2.53	2.10	1.56	.28	1.84	5.58	0.377	0.174	0.612
XIV	2.32	.001	.19	.14	.32	1.34	.17	.05	.22	3.57	0.326	0.092	0.716
XVII	4.03	.016	7.83	2.49	10.31	3.15	7.12	.85	7.97	8.39	0.485	0.190	1.034
XVII	4.24	.015	7.19	2.33	8.52	3.09	6.54	.79	7.33	8.23	0.485	0.190	1.034
XVII	10.98	.025	10.70	3.85	14.55	2.78	9.73	1.31	11.04	7.41	0.427	0.211	1.057
XVIII	4.31	.009	3.74	1.38	5.12	2.70	3.40	.47	3.87	7.21	0.427	0.211	1.057

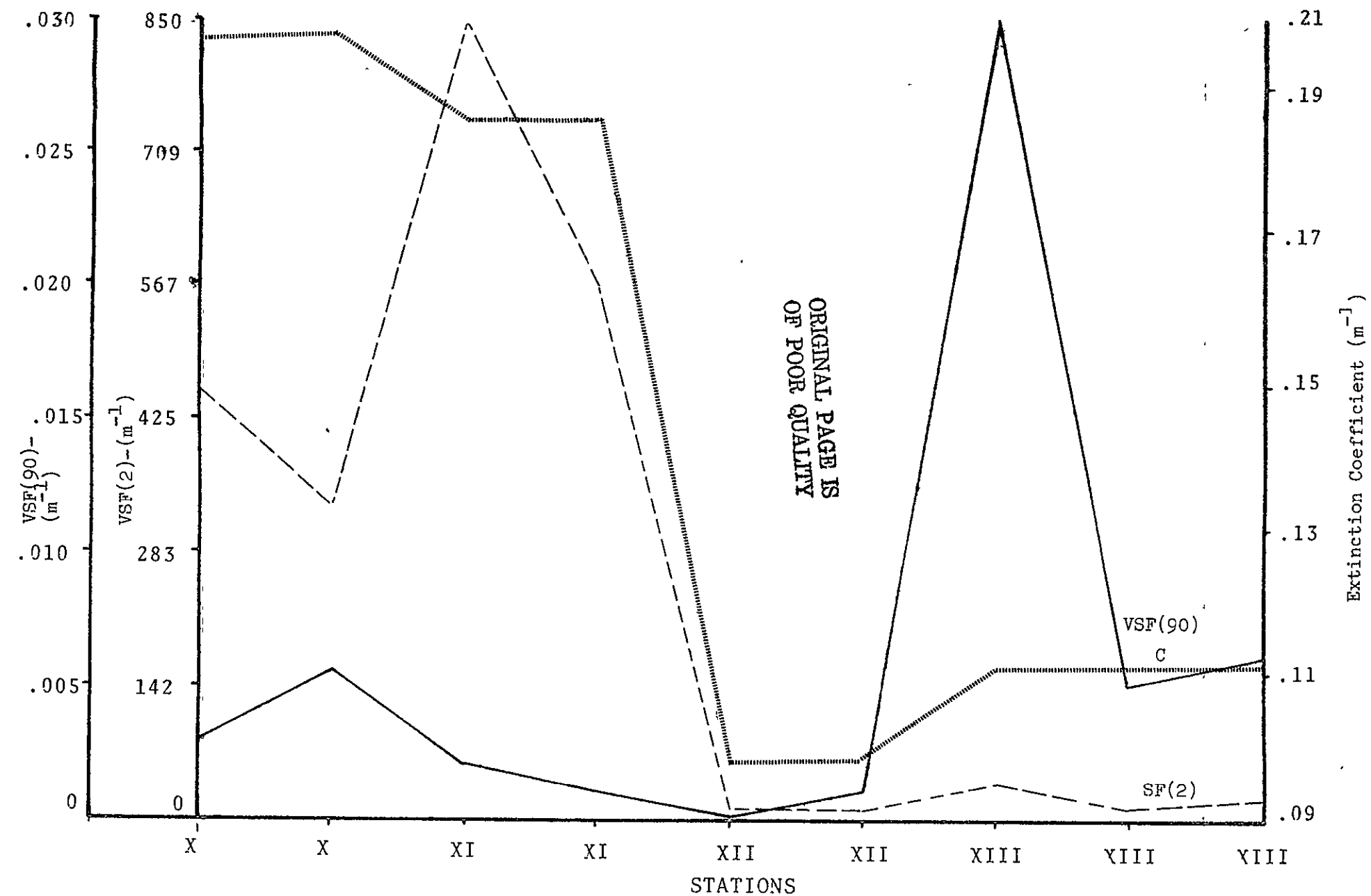


Fig. 7. Selected VSF(90), VSF(2), and Extinction Coefficient Measurements
For Leg III (Stations X-XII)

scattering (VSF (90)) and 2° scattering (VSF (2)) appear to be in direct relationship to the independent transmissometer readings. As the particulate matter increased, so did the light extinction coefficient. At present, the 2° scattering does not appear to be directly correlatable to the total chlorophyll content. When total chlorophyll concentrations were at their highest, the 2° scattering was not at its maximum.

The organic mass was then plotted with the inorganic mass (Figure 8) and also with the total chlorophyll concentration. The OM and IM, while the organic mass was much higher, followed each other almost directly. Organic mass predictions also did not correlate with the chlorophyll measurements. As mentioned by McCluney (1975), the OM should best be correlated with chlorophyll a and c. No obvious correlation was seen, however, in the sampled Gulf waters containing the previously mentioned organisms (Figure 9). Peaks in total chlorophyll a, b, and c occurred where there was no maximum peak in 2° scattering.

Station B was then plotted. The independent readings from the transmissometer follow the curves for the 2° and 90° readings almost directly (Figure 10). Again the predicted OM and IM followed each other quite closely, the OM being the

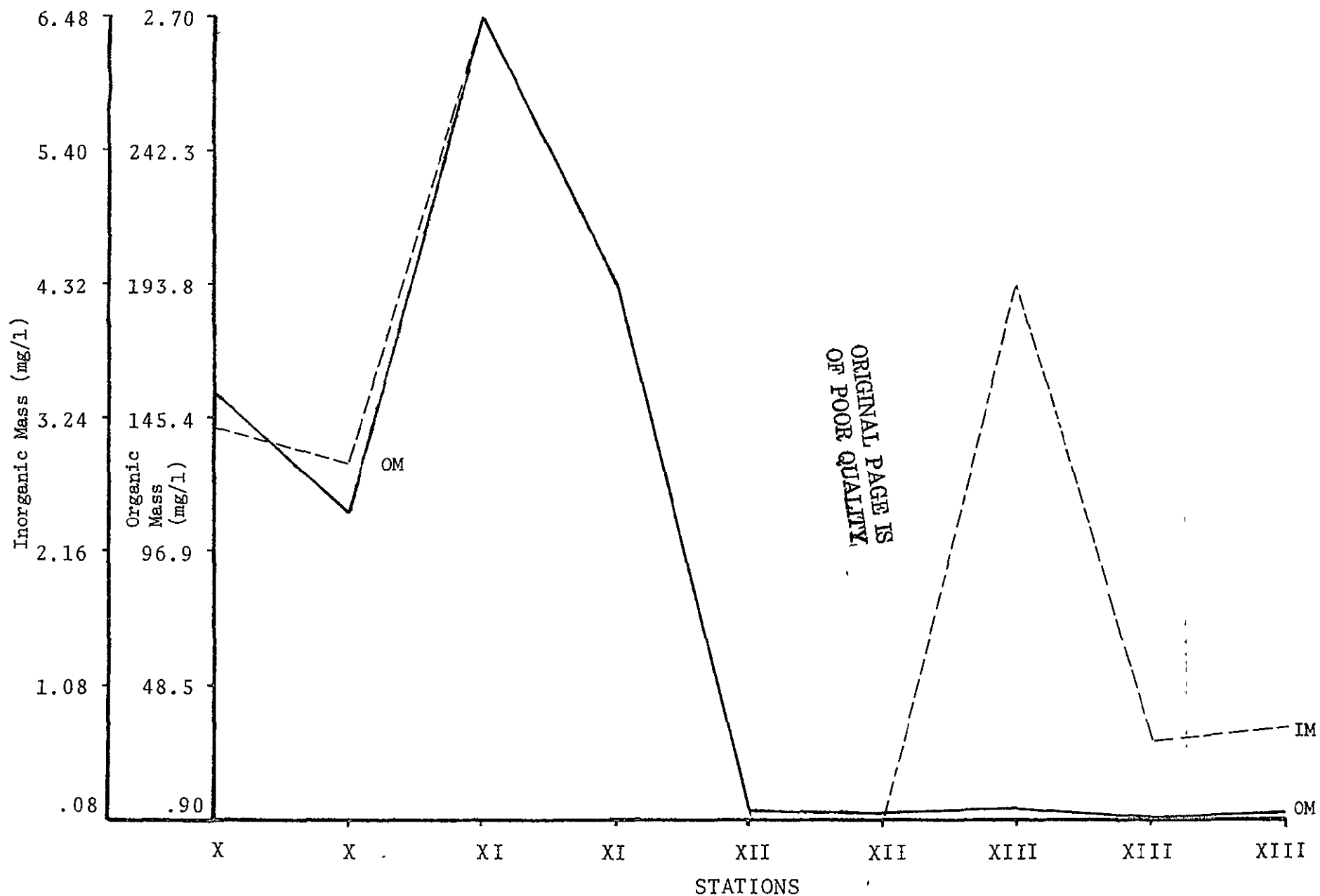


Fig. 8. Selected Predicted Organic Mass and Inorganic Mass Measurements for Leg III (Stations X-XIII)

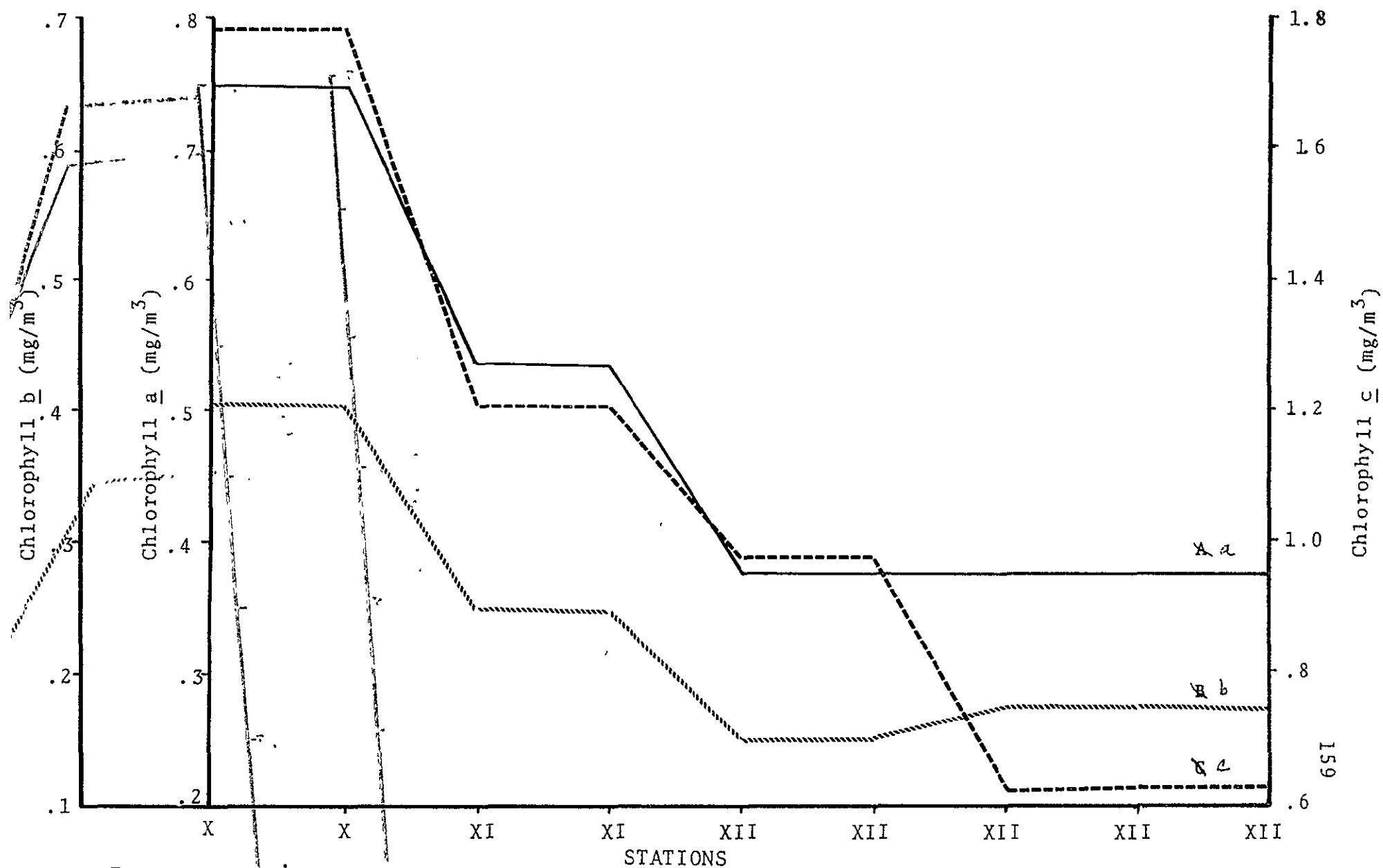


Fig. 9. Selected Total Surface Chlorophyll a, b, c Concentrations for Leg III (Stations X-XII)

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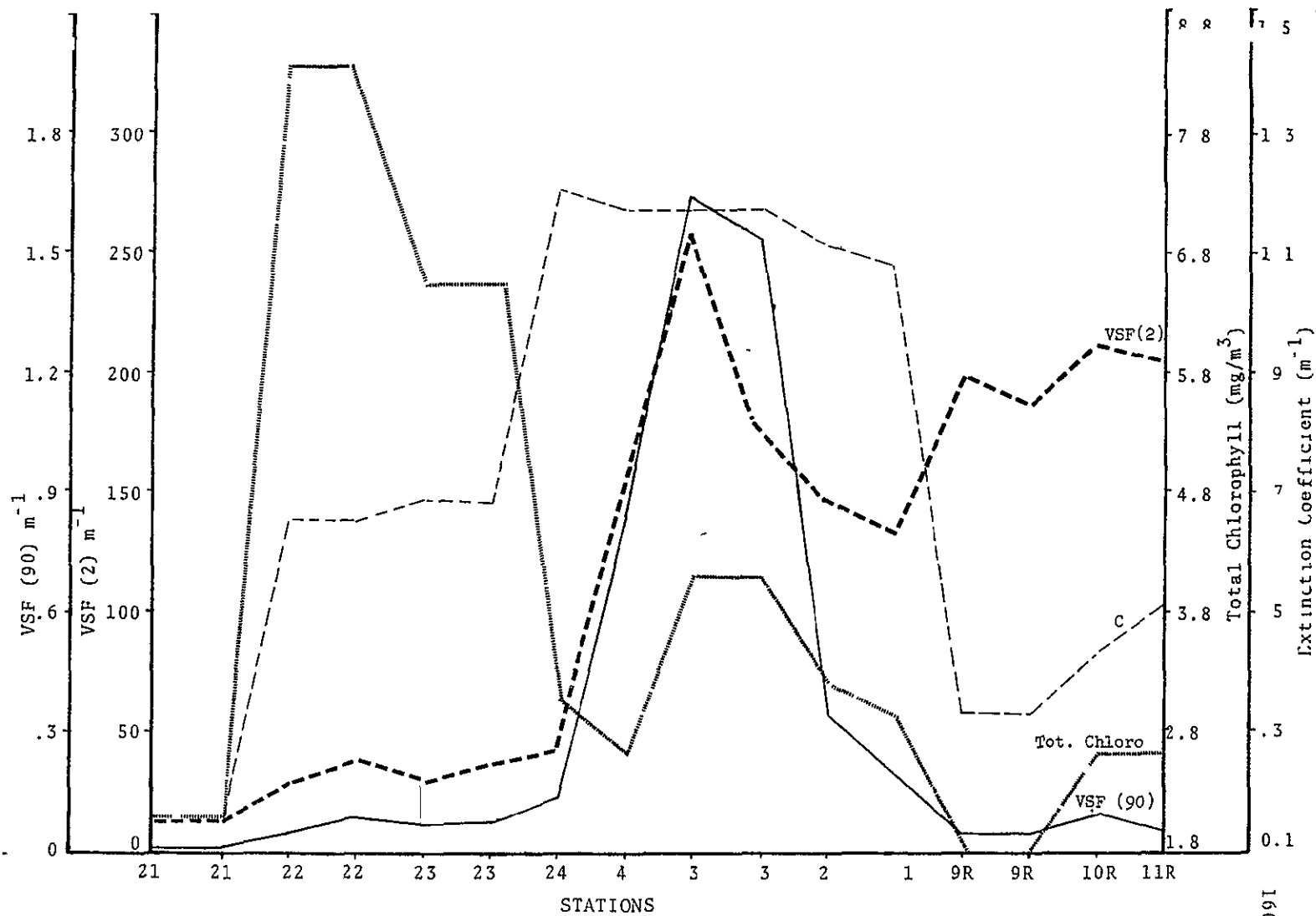


Fig 10 Selected Correlative Mississippi Plume Measurements After New Orleans In Order of Occurance.

highest of the two (Figure 11). When compared to the total chlorophyll a, b, and c (Figure 12) there is very little to be observed. The total chlorophyll appears to steadily decline, while both OM and IM randomly increase and decrease.

Lastly, Station C was plotted. The 2° and 90° scattering was not in as direct a relationship with the extinction coefficient as had been previously observed (Figure 13). Due to the small number of readings, the total chlorophyll concentrations were plotted with the predicted OM and IM (Figure 14). There appeared to be a better correlation between the predicted OM and the chlorophyll measurements, but still, with such few samples, no outstanding conclusions can be drawn.

The scattering meter will have to be operated in many different areas of the globe so as to examine the response of different organisms, and different inorganic particles under varying environmental conditions to 90° and 2° scattering. Quantitative measurements of sediment concentrations should also be made in future studies so as to determine the accuracy of the predicted inorganic particulate concentrations.

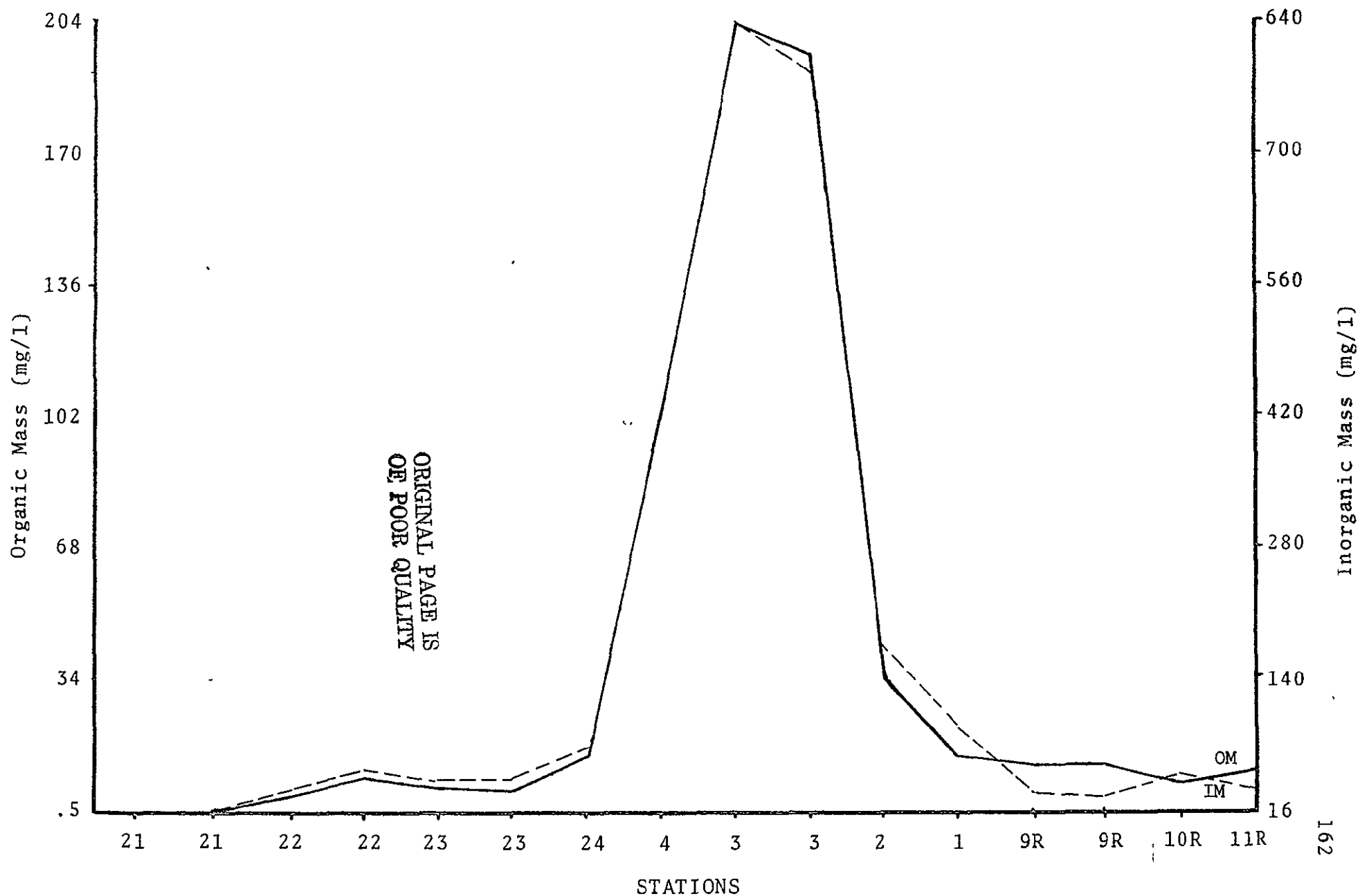


Fig. 11 Selected Predicted Organic Mass and Inorganic Mass Measurements
For Leg II (After New Orleans)

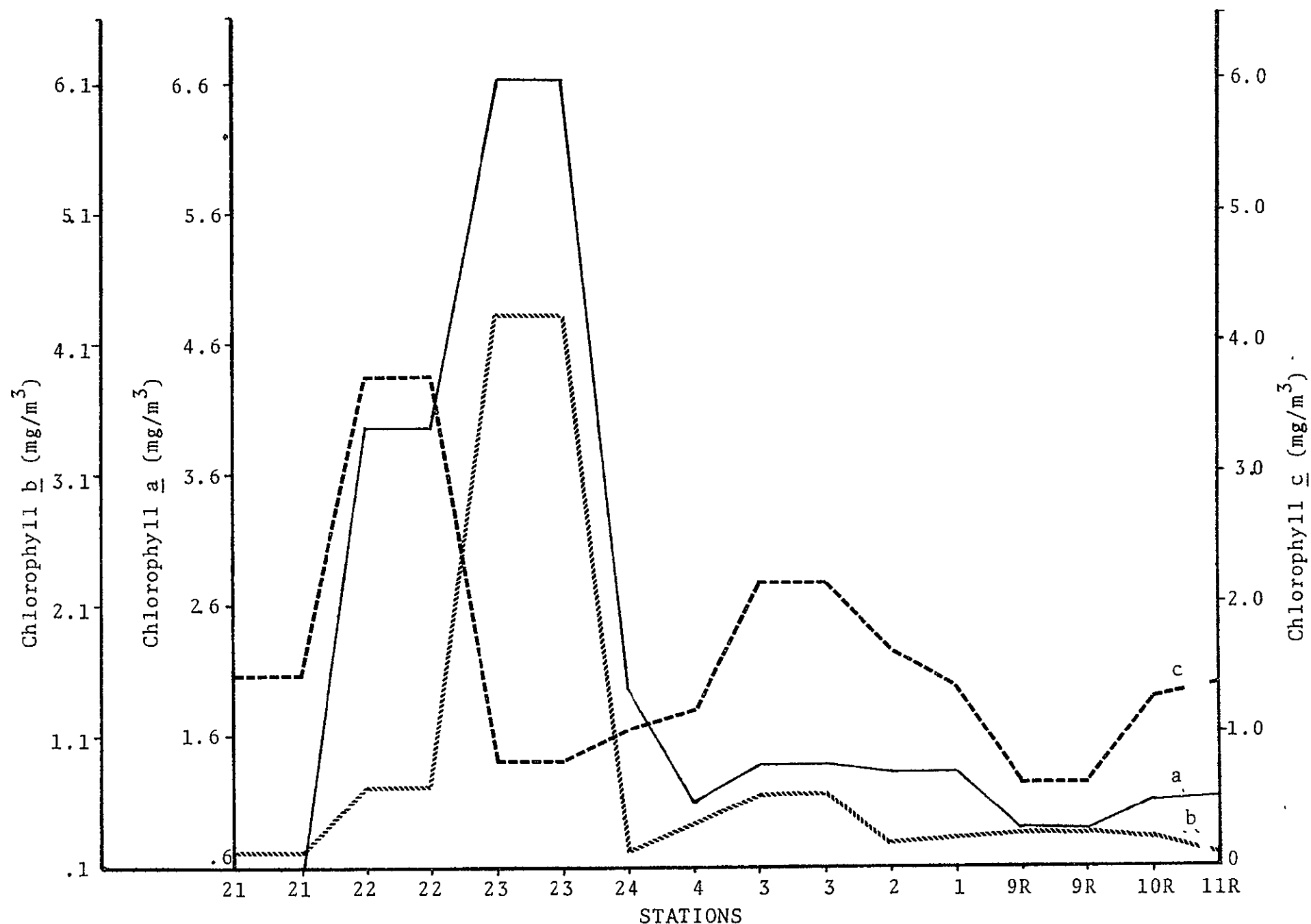


Fig. 12 Selected Total Surface Chlorophyll a, b, and c Concentrations for Leg II (After New Orleans

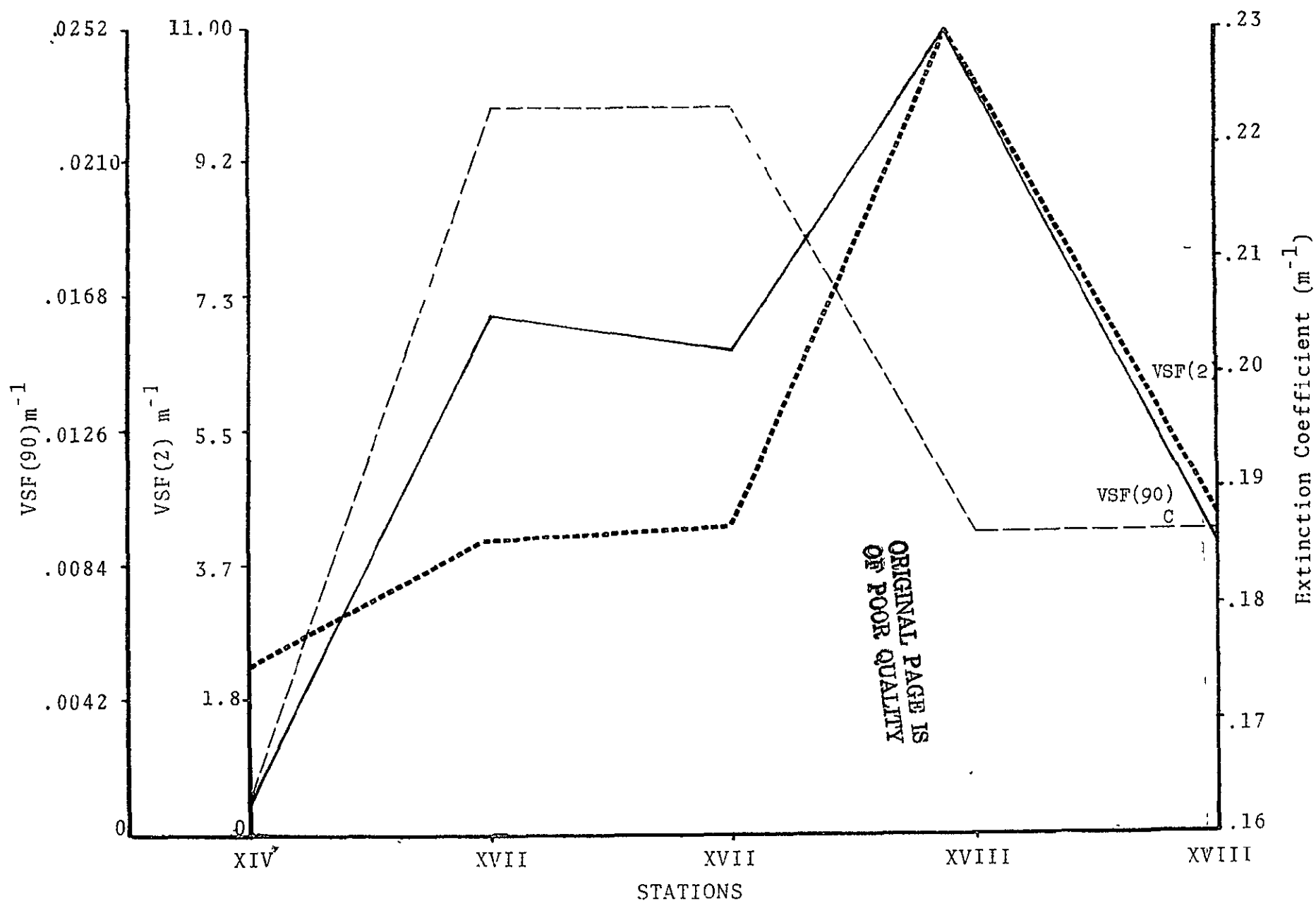


Fig. 13 Selected VSF(90), VSF(2), and Extinction Coefficient Measurements for Leg III (Stations XIV-XVII)

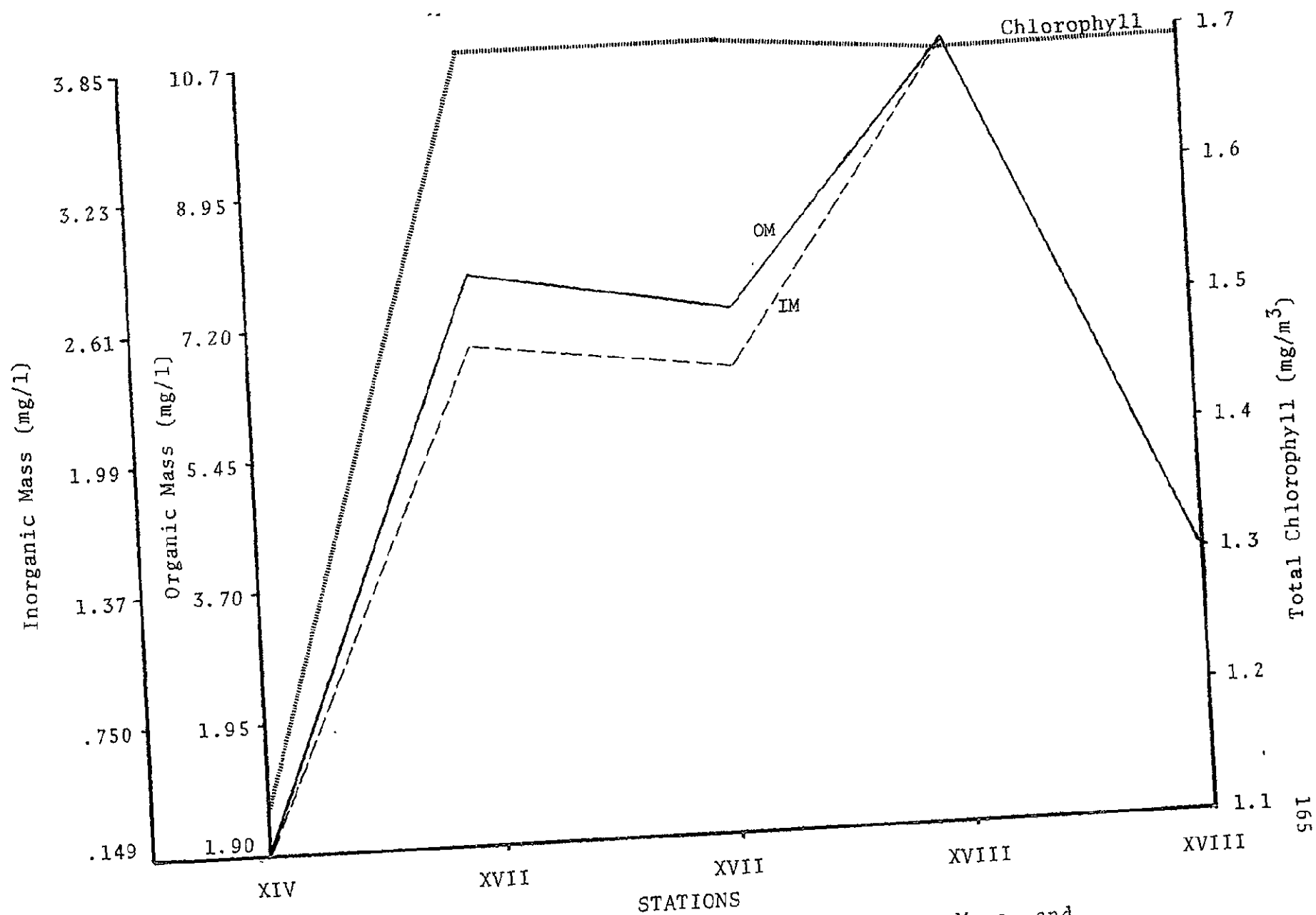


Fig. 14. Selected Correlative Organic Mass, Inorganic Mass, and Chlorophyll Measurements for Leg III (Stations XIV-XVII).

From spending a great amount of time with the instrument and observing the results, one author (Hill) feels that with time and a few improvements, this $2^{\circ}/90^{\circ}$ scattering meter will be capable of measuring organic and inorganic particulate concentrations. The many hours of observing the continuous data collected on chart paper gave a better idea of how general trends within the surrounding water masses are recorded by the instrument. The data worked with in this report is merely point data that doesn't, at this stage in the analysis, readily indicate the crossing of various water boundaries. General trends such as entering a sediment laden river plume from clear marine waters or leaving coastal waters to enter open ocean waters were quite obvious over a long period of observing the continuous data. Both organic and inorganic patterns could be better observed through the use of the continuous data.

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When the surface temperature increased, the chlorophyll bearing organisms may have moved to lower, cooler depths in the water column. The bucket temperature measurements will be compared at a later date to the PRT-5 skin temperature data for correlative studies with NOAA III/VHRR data and LANDSAT imagery. Studies will also be conducted to compare chlorophyll concentrations with salinity and temperature measurements at the different depths to possible substantiate the location and vertical

migration patterns of the phytoplankton populations within the water column. A summary of the surface measurements of Legs I, II and III (Appendix C) has been added for the convenience of those interested in further correlative investigations.

5.0 INITIAL PROCESSING OF SATELLITE AND AIRCRAFT IMAGERY

The existence of remote sensing systems in orbit around the earth make available a vast amount of data useful for the monitoring of natural resources and environment. With this new wealth of data there has also come a need to efficiently process and make readily available and tremendous quantity of data in the form of pertinent information. The following describes the approach being taken to attain this end for the present project.

While surface truth measurements were being collected from the R/V CALYPSO, NOAA and NASA were collecting both satellite and aircraft imagery of the same areas. The NOAA satellite data includes the thermal infrared regions as well as the visible.

While at NASA/GSFC the TAMU personnel decided that NOAA imagery taken over the areas of interest of both the U-2 flight areas and the other sampling stations might prove to be of comparative value. The visible and infrared imagery received from the Very High Resolution Radiometer (VHRR) aboard the NOAA-3 satellite was collected and partially supplied by NOAA/NESS. Tables 3 and 5 list the images and tapes presently in hand. This data has been received at the Remote Sensing Center (RSC) in the form of nine track, 1600 bits per inch (BPI) tapes. In general, a few preliminary steps have had to be taken before further processing could

TABLE 3
AVAILABLE CALYPSO NOAA IMAGE DATA

Tape ID. No.	Orbit #	Type	Date	Satellite	Night/ Day(s)	Ship's Location
306:14:44:15	4473	V3F4451	2 Nov 74	NOAA3	10S(2)	Not yet sampling
306:14:44:15	4473	I3F4451	2 Nov 74	NOAA3	10S(2)	
307:01:40:30	4479	I1F0001	3 Nov 74	NOAA3	3N(2)	Not yet sampling
309:14:24:21	4510	V3F4451	5 Nov 74	NOAA3	95	Not yet sampling
309:14:24:22	4510	I3F4451	5 Nov 74	NOAA3	95	
314:02:09:56	4566	I	9 Nov 74	NOAA3	Night	Mudhole--not located
	4566	I1F0001	10 Nov 74	NOAA3	3N	Tampa Bay, Fla.
				0800-0912	IIA	27°23'0N/82°57'5W
				1007-1115	IIB	27°26'5N/82°59'3W
				1201-1830	IIC	27°34'N/83°02'W
	4603	I(1F0001)	12 Nov 74	NOAA3	Night	Enroute to Sta. III
317:14:07:04	4609	V3F	13 Nov 74	NOAA3	95	Panama City
317:14:04:50	4609	I0E4000	13 Nov 74	NOAA3	95(2)	
				0810-0915	IIIA	29°32'N/85°28'W
				1016-1112	IIIB	29°34'N/85°32'7W
				1154-1830	IIIC	29°38'6N/85°39'0W
327:14:13:28	4733	V3F4451	23 Nov 74	NOAA3	95	Docked in Pensacola, Fla.
327:14:13:30	4733	I3F4451	23 Nov 74	NOAA3	95	

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TABLE 4
AVAILABLE CALYPSO NOAA TAPE DATA

Tape ID. No.	Orbit #	Type	Sensor	Satellite	Date	Ship's Location
EPG 210	4473	VIS	VHRR	NOAA3	2 Nov 74	Not yet sampling
EPG 211	4473	IR	VHRR	NOAA3	2 Nov 74	
EPG 212	4479	IR	VHRR	NOAA3	3 Nov 74	Not yet sampling
EPG 246	4510	VIS	VHRR	NOAA3	5 Nov 74	Not yet sampling
DPG 247	4510	IR	VHRR	NOAA3	5 Nov 74	
EPG 223	4566	IR	HRPT	NOAA3	9 Nov 74	Mud Hole, Fla. not located
EPG 926	4607	VIS		NOAA3	13 Nov 74	Panama City, Fla. 0810-0915 IIIA 29°32'N/85°28'W 1016-1112 IIIB 29°34'N/85°32'W 1154-1830 IIIC 29°38'6N/85°39'0W
EPG 260	4733	IR	VHRR	NOAA3	23 Nov 74	Docked in Pensacola, Fla.

continue. The tapes must first be unblocked (if necessary) so one logical record equals one physical record. The density must also be reduced from its original 1600 BPI to 800 BPI. This must be done on Texas A&M's IBM 360/65 computer.

The data is then in a form that can be interpreted by the Interactive Resource Information Management and Analysis System (IRIMAS) (Schell, 1974) which is implemented on a Texas Instrument's minicomputer (TI Model 980A) which is the heart of the RSC's Remote Sensing Data Analysis Facility (RSDAF) (Figure 15). The system is augmented with a dynamic color display for image presentation and Versatec printer/plotter for a graphic representation of the data. Other peripheral equipment includes a tape drive, disc pack, card reader, a TI Silent 700 electronic data terminal equipped with a cassette drive which when combined provide an excellent user interactive system.

IRIMAS was developed by the RSC to provide a convenient interactive link between earth observations data and its users. Among its many features are two functions which have greatly simplified the processing of VHRR data. They are "Display" and "Histogram". "Display" allows for the visual observation of data directly from the tapes. "Histogram" presents the raw or processed data as the number of values present within each of the many data levels.

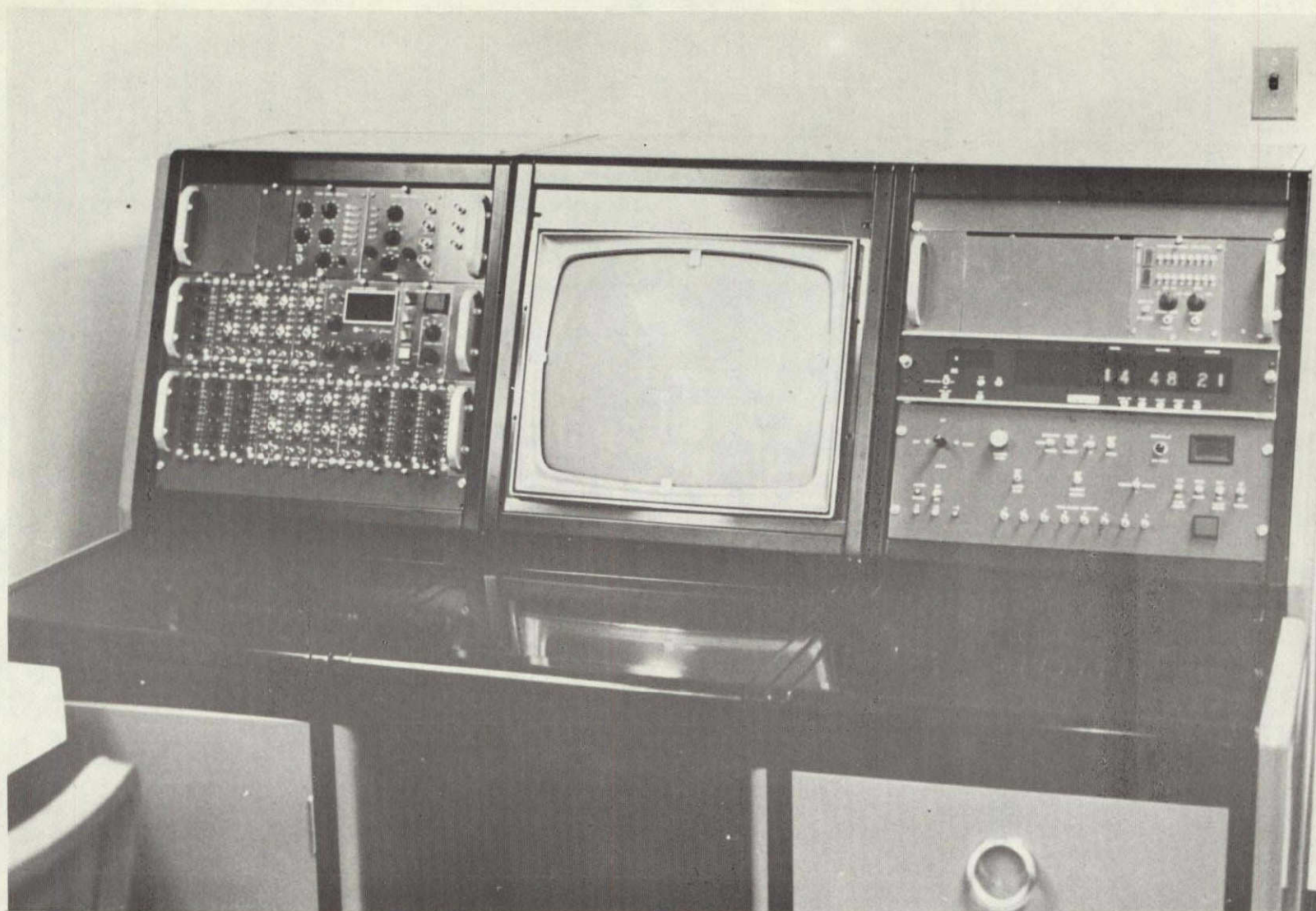


Fig. 15. The Digital Color Display With Companion
Computer (from Bruns, 1973).

In the initial processing of the VIHR tapes, before the development of IRIMAS, a grey scale map of a large area from the data on the tape was produced. The grey scale map was then viewed and by the selection of various reference points (easily recognized land marks) the area of interest was located. A second execution of the program was then performed to "zoom in on" and retrieve the information for the smaller area. This process, although costly and time consuming, was quite necessary to produce the desired result which was a reduced grey scale map of the area of interest. For the user interaction, a tape is now viewed using IRIMAS and the color display (Figure 16). The area of interest may now be rapidly and inexpensively located for various correlative studies. The "Histogram" feature is then used to give the distribution of the values of a given area to more accurately display and plot the data.

At present, isoline contouring is being implemented to act on the data supplied by the histogram function of IRIMAS. The contouring will be applied to determine boundaries of water masses as depicted by the measured parameters.

The process of getting the NOAA-3 data into a format that can be used on the Texas A&M computers has been accomplished for the tapes NOAA/NESS furnished directly. We are currently searching for other related data tapes that



Fig. 16. Example of Color Reconstruction of LANDSAT Image Showing College Station, Texas Area (Brazos River) (from Bruns, 1973).

various film making projects. Storm patterns had to be studied so as to allow the CALYPSO, a wooden hulled vessel, sufficient time to leave the reef laden waters in search of safe anchorage.

Various dignitaries from not only the United States, but the Central American countries as well, visited the CALYPSO. Included in the tour of the ship was an explanation and demonstration of NASA's APT and ATS systems, often very impressive to the visitors.

Once the science had begun, the APT system was used to plan sampling stations and U-2 flights over the areas of interest. The CALYPSO had to be properly positioned and in operational readiness if the U-2 was to be flown over the area of sampling interest. The main goal of the scientific effort was to collect surface truth measurements in tandem with imagery taken from a high flying U-2 aircraft carrying the NASA/GSFC produced prototype Ocean Color Scanner (OCS).

The ATS system was used for communications between ships operations units, the Cousteau Society, the scientific factors (Texas A&M University and GSFC), and families (Figure 17). Very often the ship, being an older ship, needed parts immediately and the parts could be ordered and received much

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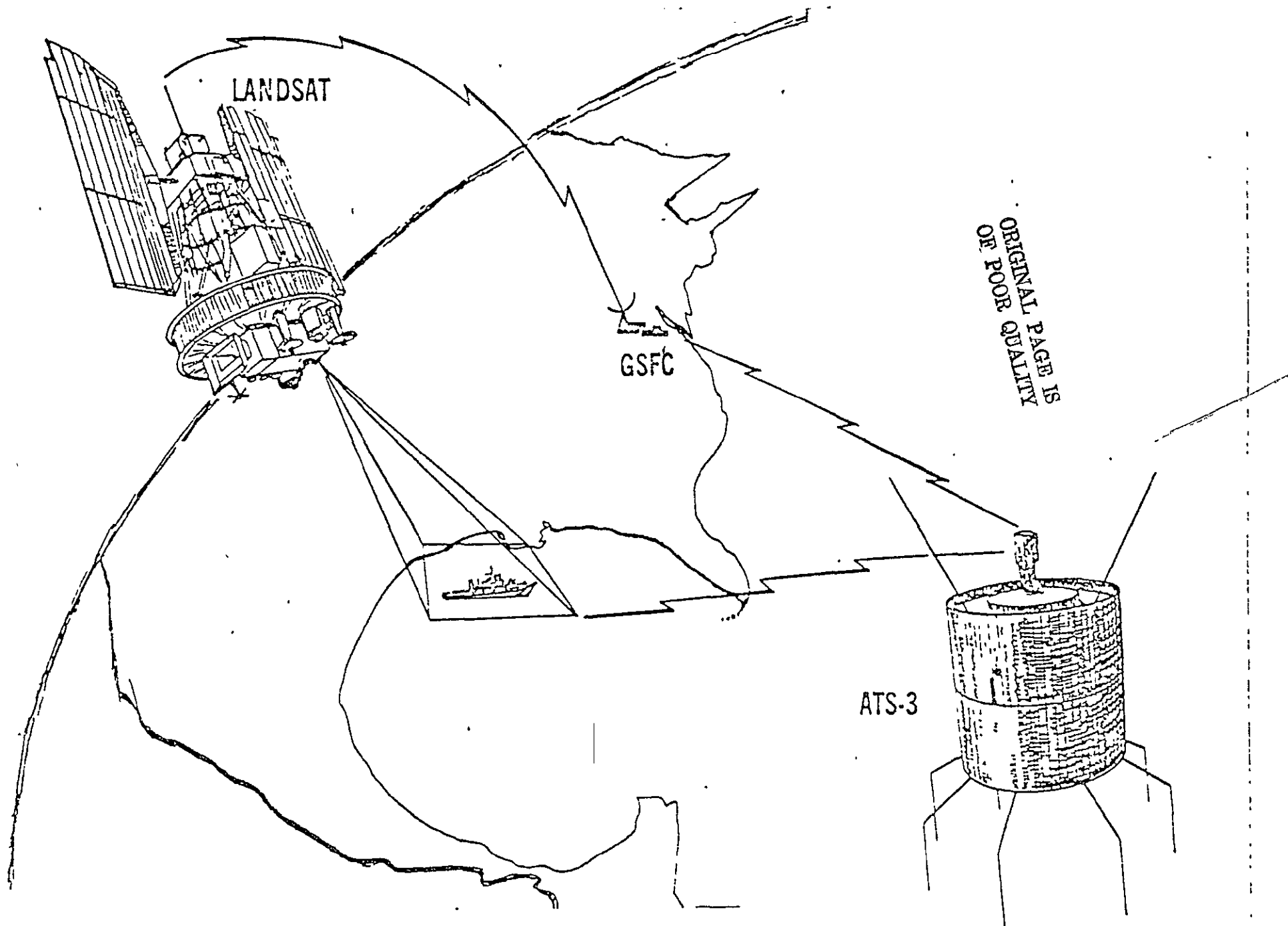


Fig. 17. Data Acquisition and Communications Network (from Barker, 1975)

sooner through the ATS system than through the normal channels. During one portion of the cruise, the ship was without a formal radio operator and the ATS system became the prime communication system, being much easier to operate than the ship's radio. During a study of the effects of the plume waters of the Mississippi River upon the Gulf of Mexico, an emergency arose involving the CALYPSO helicopter. The ATS system is arranged in such a manner that in an emergency anyone can break into the satellite system and conduct the necessary communications. Again this system proved to be invaluable.

The scientific equipment, including some prototype models, required close communications between ship and shore. Questions and information about instrumentation was quickly transmitted verbally and in printed format to the GSFC scientists. The answers, often accompanied with drawings, were received quickly, and sometimes immediately.

Scientific data, which could be rapidly obtained, was also relayed back to GSFC for quick analysis and an evaluation of the ongoing CALYPSO operations. During the plume study, a separate study was begun to see if LANDSAT imagery could be utilized on a near real-time basis to locate the direction of flow of the plume and related areas

C-2

of interest (Barker, et al., 1975). LANDSAT imagery was relayed from GSFC to the scientists of the CALYPSO via slow scan facsimile over a VHF relay on the ATS satellite to a synchronized facsimile recorder onboard the ship. The rapid analysis and transmission of the LANDSAT imagery greatly enhanced the scientific effort onboard the CALYPSO. For the first time ever, researchers on a functioning oceanographic research vessel were aided by near real-time LANDSAT imagery. The scientists successfully located and sampled the many boundary zones associated with the fresh, cooler, sediment laden, Mississippi plume waters that were entering a warmer, clearer, marine environment.

Various migrations of organisms in the oceans are spurred by changes in atmospheric conditions. Dr. Herrnkind (1975) has noted that lobster migrations are encouraged by hurricanes, storm fronts, or shifting winds. Herrnkind and Captain Cousteau, anxious to film a migration in progress, continuously observed the APT weather imagery in hopes of predicting an annual lobster migration off the Yucatan Peninsula near the island of Contoy. A storm finally did instigate a migration in the area. This storm had been followed and predicted by the crew and scientists of the CALYPSO, allowing them to be prepared for the filming.

The ATS/APT systems also aided the crew in the often critical navigational operations of the ship. These satellite systems enabled the scientists onboard to not only successfully carry out planned experiments, but when the occasion arose, made it possible to perform additional scientific investigations that would otherwise have been impossible.

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APPENDIX A
TRANSMISSOMETER DATA WITH DEPTH--INCLUDING
EXTINCTION COEFFICIENT, TOTAL CHLOROPHYLL, AND SALINITY DATA

LEG I

TRANSMISSOMETER DATA WITH DEPTH

Location: I Mud HoleDate: Nov. 9, 1974Euphotic Zone (m): A=12.6, B=10.0

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
A 0800	0.0			3.435	35.024
	5.0			3.177	35.020
B 1050	0.0			4.583	34.653
	5.0			3.757	34.652
NOT ACQUIRED AT THIS STATION					

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TRANSMISSOMETER DATA WITH DEPTH

Location: II Tampa BayDate: Nov. 10, 1974Euphotic Zone (m): A=22.4, B=25.3, C=28.0

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
A 0800	0.0	--	--	1.753	35.181
	5.0	.685	.3783	1.723	35.169
	10.0	.684	.3798	1.734	35.170
	12.0	.685	.3783		
B 1025	0.0	--	--	1.753	35.276
	5.0	.670	.4005	2.072	35.285
	10.0	.660	.4155	1.750	35.299
	15.0	.663	.4110		
	20.0	.682	.3827		
C 1215	0.0	--	--	1.753	35.326
	5.0	.630	.4308	2.299	35.319
	10.0	.658	.4186	2.059	35.319
	15.0	.668	.4035		
	20.0	.686	.3769		

TRANSMISSOMETER DATA WITH DEPTH

Location: III Panama CityDate: Nov. 13, 1974Euphotic Zone (m): A=10.0, B=30.0, C=25.3

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
A 0834	.33	.546	.6051	2.846	34.243
	6.0	.544	.6070	2.811 (5m)	34.279
	7.5-10	.525	.6444	2.831 (8m)	34.237
A 0845 (Repeat)	.33	.520	.6539		
	5.0	.531	.6330		
	7.5	.532	.6311		
B 1032	.33	.700	.3567	1.709	34.375
	5.0	.699	.3581		
	7.5	.692	.3682	1.443	
	10.0	.660	.4155	1.190	34.353
	15.0	.617	.4829		34.350
C 1206	.33	.677	.3901	1.989	34.525
	5.0	.692	.3682	2.003	34.497
	7.5	.692	.3682		
	10.0	.678	.3886	2.017	34.517
	12.5	.678	.3886		
	15.0	.667	.4050	1.709	34.498
	17.5	.661	.4140		

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TRANSMISSOMETER DATA WITH DEPTH

Location: IV Timbalier BayDate: Nov. 15, 1974Euphotic Zone (m): A=7.6, B=10.0, C=12.6

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
A 0842	.33	.388	.9467	1.989	33.464
	2.5	3.72	.9889		
	5.0	.360	1.0217	1.695	33.473
B 1026	.33	.475	.7444	1.989	33.829
	5.0	.472	.7508	1.763	33.814
	7.5	.462	.7722		
	9.0	.334	1.0966	1.734 (10m)	33.828
B 1050	.33	.465	.7657		
(Repeat)	5.0	.464	.7679		
	7.5	.460	.7765		
	10.0	.456	.7853		
C 1215	.33	.512	.6694	2.003	34.461
	5.0	.496	.7012	1.750	34.465
	7.5	.488	.7174		
	10.0	.493	.7072	1.721	34.458

TRANSMISSOMETER DATA WITH DEPTH

Location: V Mississippi River Plume--SW PassDate: Nov. 17, 1974ORIGINAL PAGE IS
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TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
A 0806	.33	.282	1.2658	1.789	24.215
	5.0	.284	1.2588	1.763	30.301
	7.5	.299	1.2073		
	10.0	.321	1.1363	1.736	31.834
	12.5	.325	1.1239		
	15.0	.362	1.0161		
	17.5	.372	.9889		
	17.5	.368	.9997		
	15.0	.359	1.0244		
	12.5	.315	1.1552		
	10.0	.317	1.1489	1.736	31.834
	7.5	.332	1.1026		
	5.0	.287	1.2483	1.763	30.301
	.33	.279	1.2765	1.789	24.215
B	.33	No Reading		2.346	24.373
	5.0	Helicopter Accident		1.202	31.809
	7.5				
	10.0			1.175	32.686
C 1550	.33	.439	.8233	2.881	31.772

TRANSMISSOMETER DATA WITH DEPTH

Location: V (Continued)Date. Euphotic Zone (m):

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
	5.0	.441	.8187	2.293	31.854
	7.5	.467	.7614		
	10.0	.534	.6274	1.763	32.864
	12.5	.534	.6274		
	15.0	.510	.6733	1.763	33.033
	17.5	.491	.7113		
	20.0	.491	.7113		
	22.5	.515	.6636		
	25.0	.498	.6972		
	22.5	.506	.6812		
	15.0	.492	.7093	1.763	33.033
	12.5	.480	.7343		
	7.5	.512	.6694		
	.33	.446	.8074	2.881	31.772

TRANSMISSOMETER DATA WITH DEPTH

Location: VI Mobile BayORIGINAL PAGE IS
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TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
A 0840	.33	.775	.2545	0.587	34.640
	5.0	.783	.2446	0.853	34.472
	7.5	.785	.2421		
	10.0	.785	.2421	0.853	34.481
	12.5	.776	.2536		
	15.0	.770	.2614		
	17.5	.776	.2666		
	20.0	.752	.2850	1.134	34.483
	20.0	.762	.2718	1.134	34.483
	17.5	.772	.2588		
	15.0	.779	.2497		
	12.5	.796	.2282		
	10.0	.800	.2231	0.853	34.481
	7.5	.799	.2244		
	5.0	.792	.2332	0.853	34.472
B 1030	.33	.768	.2640	1.134	34.194
	5.0	.761	.2731	0.866	34.173
	7.5	.760	.2744		
	10.0	.760	.2744	1.427	34.221

TRANSMISSOMETER DATA WITH DEPTH

Location: VI (Continued)

Date: _____

Euphotic Zone (m): _____

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
C 1255	12.5	.764	.2692	0.866	34.522
	15.0	.765	.2679		
	17.5	.753	.2837		
	20.0	.742	.2984		
	22.5	.745	.2944		
	25.0	.727	.3188	0.866	34.522
	22.5	.732	.3120		
	20.0	.765	.2679		
	17.5	.794	.2309		
	15.0	.830	.1863		
	12.5	.830	.1863	1.427	34.221
	10.0	.823	.1948		
	7.5	.828	.1887		
	.33	.829	.1875	1.134	34.194
	.33	.699	.3581	1.147	34.316
	5.0	.702	.3538	1.147	34.300
	7.5	.740	.3011	1.440	34.304
	10.0	.740	.3011		
	12.5	.735	.3079		

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TRANSMISSOMETER DATA WITH DEPTH

Location: VII DeSoto CanyonDate: Nov. 19, 1974Euphotic Zone (m): A=50.4, B=45.0, C=76.0

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
A 1143	.33	.767	.2653	1.121	35.384
	5.0	.784	.2433	1.386	35.378
	7.5	.791	.2345		
	10.0	.792	.2332	1.667	35.421
	12.5	.791	.2345		
	15.0	.794	.2307		
	17.5	.800	.2231		
	20.0	.866	.1439	1.415	35.495
	17.5	.800	.2231		
	15.0	.822	.1960		
	12.5	.820	.1985		
	10.0	.805	.2169	1.667	35.421
	7.5	.804	.2182		
	5.0	.806	.2157	1.386	35.378
	.33	.792	.2332	1.121	35.384
B 1337	.33	.850	.1625	0.840	36.009
	5.0	.855	.1567	0.853	36.007
	7.5	.856	.1555		
	10.0	.854	.1878	0.840	36.020

TRANSMISSOMETER DATA WITH DEPTH

Location: VII (Continued)

Date: _____

Euphotic Zone (m): _____

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
C 1605	12.5	.850	.1625		
	15.0	.850	.1625		
	15.0	.856	.1555		
	12.5	.852	.1602		
	10.0	.856	.1555	0.840	36.020
	7.5	.855	.1567		
	5.0	.858	.1532	0.853	36.007
	.33	.860	.1508	0.840	36.009
	.33	.846	.1672	0.853	35.990
	5.0	.841	.1732	0.853	35.978
	7.5	.839	.1755		
	10.0	.832	.1839	0.587	36.003
	12.5	.830	.1863		
	15.0	.830	.1863		
	17.5	.832	.1839		
	12.5	.835	.1803		
	15.0	.830	.1863		
	17.5	.832	.1839		
	12.5	.835	.1803		

TRANSMISSOMETER DATA WITH DEPTH

Location: VIII PensacolaDate: Nov. 20, 1974Euphotic Zone (m): A=25.3, B=28.6, C=25.3

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
A 0822	.33	.670	.4005	1.427	33.657
	5.0	.668	.4035		
	7.5	.692	.3682		
	10.0	.742	.2984		
	12.5	.746	.2930		
	17.5	.739	.3025		
	15.0	.713	.3383		
	12.5	.726	.3202		
	10.0	.742	.2984		
	7.5	.678	.3886		
	5.0	.682	.3827		
	.33	.675	.3930	1.427	33.657
B 1105	.33	.727	.3188	1.721	34.562
	5.0	.745	.2944		
	7.5	.760	.2744		
	10.0	.757	.2784		
	12.5	.756	.2797		
	15.0	.755	.2810		
	17.5	.535	.6255		

TRANSMISSOMETER DATA WITH DEPTH

Location: VIII (Continued)

Date: _____

Euphotic Zone (m): _____

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
C 1319	20.0	(bottom)			
	15.0	.2944	.2944		
	12.5	.2824	.2824		
	10.0	.2718	.2718		
	7.5	.2784	.2784		
	5.0	.2705	.2705		
	.33	.2877	.2877	1.721	34.562
	.33	.785	.3079	1.161	34.602
	10.0	.740	.3011		
	15.0	.750	.2877		
	20.0	.420 (bot)	.8675		
	15.0	.750	.2877		
	10.0	.750	.2877		
	5.0	.735	.3079		
	.33	.740	.3011		

LEG II
TRANSMISSOMETER DATA WITH DEPTH

Location: Station A

Date: Nov. 26, 1974

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Euphotic Zone (m): No Reading

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
2150	.33	.77	.2614	2.047	34.990
	5.0	.77	.2614	1.836	33.524
	7.5	.77	.2614		
	10.0	.76	.2744	2.352	34.998
	12.5	.76	.2744		
	15.0	.76	.2744		
	17.5	.76	.2744		
	20.0	.77	.2614	2.618	34.990
	17.5	.77	.2614		
	15.0	.77	.2614		
	12.5	.76	.2744		
	10.0	.76	.2744	2.352	34.998
	7.5	.77	.2614		
	5.0	.77	.2614	1.836	33.524
2200	.33	.77	.2614	2.047	34.990

TRANSMISSOMETER DATA WITH DEPTH

Location: Station BDate: Nov. 27, 1974Euphotic Zone (m): No Reading

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity °/°
0325	.33	.70	.3567	2.340	33.531
	5.0	.70	.3567	2.618	34.997
	7.5	.70	.3567		
	10.0	.70	.3567	2.324	33.513
	12.5	.70	.3567		
	15.0	.69	.3711	2.645	33.540
	17.5	.69	.3711		
	20.0	.68	.3857		
	17.5	.68	.3857		
	15.0	.69	.3711	2.645	33.540
	12.5	.69	.3711		
	12.5	.69	.3711		
	10.0	.68	.3857	2.324	33.513
	7.5	.69	.3711		
	5.0	.69	.3711	2.618	34.997
0333	.33	.69	.3711	2.340	33.531

TRANSMISSOMETER DATA WITH DEPTH

Location: Station CDate: Nov. 27, 1974ORIGINAL PAGE IS
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TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)	Salinity ‰
1225	.33	.652	.4277	2.990	33.486
	5.0	.654	.4249	3.537	33.451
	7.5	.656	.4216		
	10.0	.665	.4080	3.217	33.564
	12.5	.685	.3783		
	15.0	.685	.3783		
	17.5	.600	.5108		
	20.0	.510	.6733	2.938	34.624
	22.5	.495	.7032		
	25.0	.530	.6349		
	27.5	.500	.6931		
	30.0	.470	.7550	2.618	35.143
	32.5	.460	.7765		
	30.0	.460	.7765		
	25.0	.520	.6539		
	20.0	.520	.6539	2.938	34.624
	15.0	.615	.4861		
	10.0	.680	.3857	3.217	33.564
	7.0	.660	.4155		
	5.0	.660	.4155	3.537	33.451
1242	.33	.670	.4005	2.990	33.486

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 16Date: Nov. 28, 1974Euphotic Zone (m): 5.0

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³) *	Salinity ‰
0620	.33	.375	.9808	2.655	28.364
	5.0	.370	.9943	2.724	32.206
	7.5	.460	.7765		
	10.0	.510	.6733	2.068	33.547
	12.5	.590	.5276		
	15.0	.685	.3783		
	17.5	.705	.3496		
	20.0	.715	.3355	1.482	35.132
	25.0	.300	1.2040		
	30.0	.280	1.2730		
	25.0	.290	1.2379		
	22.5	.450-.550	.7985-.5978		
	20.0	.580-.650	.5447-.4308	1.482	35.132
	17.5	.705	.3496		
	15.0	.660	.4155		
	12.5	.590	.5276		
	10.0	.510	.6733	2.068	33.547
	7.5	.430	.8440		
0640	.33	.355	1.0356	2.655	28.364

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 15Date: Nov. 28, 1974Euphotic Zone (m): 25.3

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
0845	.33	.690	.3711	1.202	35.585
	5.0	.685	.3783	2.041	35.560
	7.5	.685	.3783		
	10.0	.675	.3930	1.789	35.986
	12.5	.670	.4005		
	15.0	.665	.4080		
	17.5	.660	.4155		
	20.0	.650	.4308	2.041	35.567
	25.0	.640	.4463		
	20.0	.650	.4308	2.041	35.567
	17.5	.630	.4620		
	15.0	.630	.4620		
	12.5	.630	.4620		
	10.0	.630	.4620	1.789	35.986
	7.5	.630	.4620		
	.33	.640	.4463	1.202	35.585
0855	.33	.640	.4463	1.202	35.585

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

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TRANSMISSOMETER DATA WITH DEPTH

Location: Station 14Date: Nov. 28, 1974Euphotic Zone (m): 20.8

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1050	.33	.715	.3355	1.747	35.493
	5.0	.716	.3341	1.202	35.501
	7.5	.705	.3496		
	10.0	.705	.3496	0.881	35.493
	12.5	.700	.3567		
	15.0	.700	.3567		
	17.5	.695	.3638		
	20.0	.695	.3638	0.881	35.459
	25.0	.695	.3638		
	20.0	.695	.3638	0.881	35.459
	17.5	.695	.3638		
	15.0	.695	.3638		
	12.5	.695	.3638		
	10.0	.698	.3595	0.881	35.493
	7.5	.700	.3567		
	5.0	.700	.3567	1.202	35.501
1103	.33	.700	.3567	1.747	35.493

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 13Date: Nov. 28, 1974Euphotic Zone (m): 85.0ORIGINAL PAGE IS
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TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1258	.33	.855	.1567	1.163	35.808
	5.0	.855	.1567	1.204	35.772
	7.5	.825	.1924		
	10.0	.825	.1924	1.134	35.759
	12.5	.825	.1924		
	15.0	.825	.1924		
	17.5	.825	.1924		
	20.0	.825	.1924	0.868	35.771
	15.0	.825	.1924		
	10.0	.820	.1985	1.134	35.759
	7.5	.825	.1924		
	5.0	.830	.1863	1.204	35.772
	.33	.840	.1744	1.163	35.808
1310					

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 19Date: Nov. 28, 1974Euphotic Zone (m): 18.6

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1555	.33	.650	.4308	2.083	35.649
	5.0	.650	.4308	1.774	35.582
	7.5	.655	.4231		
	10.0	.655	.4231	2.068	35.579
	12.5	.655	.4231		
	15.0	.655	.4231		
	20.0	.655	.4231	1.453	35.599
	25.0	.655	.4231		
	27.5	.655	.4231		
	25.0	.660	.4155		
	20.0	.655	.4231	1.453	35.599
	15.0	.655	.4231		
	10.0	.655	.4231	2.068	35.579
	7.5	.650	.4308		
	5.0	.650	.4308	1.774	35.582
1605	.33	.650	.4308	2.083	35.649

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 18Date: Nov. 28, 1974Euphotic Zone (m): No ReadingORIGINAL PAGE IS
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TIME	DEPTH (m)	%T	C (m^{-1})	Total Chlorophyll (mg/m^3)*	Salinity °/°°
1745	.33	.585	.5361	1.774	35.348
	5.0	.585	.5361	1.522	35.389
	7.5	.585	.5361		
	10.0	.580	.5447	1.215	35.310
	12.5	.575	.5534		
	15.0	.570	.5621		
	17.5	.570	.5621		
	20.0	.570	.5621	2.068	35.304
	25.0	.565	.5709		
	20.0	.570	.5621	2.068	35.304
	15.0	.570	.5621		
	12.5	.570	.5621		
	10.0	.570	.5621	1.215	35.310
	7.5	.565	.5709		
	5.0	.560	.5798	1.522	35.389
	.33	.565	.5709	1.774	35.348

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 12Date: Nov. 29, 1974Euphotic Zone (m): No Reading

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
0620	.33	.410	.8916	2.403	30.772
	5.0	.400	.9163	1.802	31.627
	7.5	.410	.8916		
	10.0	.525	.6444	3.028	33.413
	12.5	.550	.5978		
	15.0	.590	.5276		
	17.5	.620	.4780		
	20.0	.675	.3930	1.174	35.336
	25.0	.750	.2877		
	30.0	.790	.2357		
	25.0	.750	.2877		
	30.0	.790	.2357		
	25.0	.780	.2485		
	20.0	.705	.3496	1.174	35.336
	17.5	.670	.4006		
	15.0	.660	.4155		
	12.5	.620	.4780		
	10.0	.580	.5447	3.028	33.413
	7.5	.39	.9416	1.802	31.627
0835	.33	.39	.9416	2.403	30.772

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 11Date: Nov. 29, 1974Euphotic Zone (m): No ReadingORIGINAL PAGE IS
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TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
0810	.33	.810	.2107	2.016	35.933
	5.0	.810	.2107	1.734	35.841
	7.5	.810	.2107		
	10.0	.810	.2107	1.480	35.858
	12.5	.810	.2107		
	15.0	.810	.2107		
	17.5	.810	.2107		
	20.0	.810	.2107	1.736	35.803
	22.5	.805	.2169		
	20.0	.810	.2107	1.736	35.803
	17.5	.810	.2107		
	15.0	.810	.2107		
	12.5	.810	.2107		
	10.0	.790	.2357	1.480	35.858
	7.5	.800	.2231		
	5.0	.810	.2107	1.734	35.841
0821	.33	.810	.2107	2.016	35.933

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 10Date: Nov. 29, 1974Euphotic Zone (m): 62.0

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1008	.33	.875	.1335	1.217	35.882
	5.0	.860	.1508	1.202	35.817
	7.5	.860	.1508		
	10.0	.860	.1508	1.511	35.824
	12.5	.860	.1508		
	15.0	.850	.1625		
	17.5	.850	.1625		
	20.0	.850	.1625	1.217	35.826
	25.0	.850	.1625		
	20.0	.850	.1625	1.217	35.826
	17.5	.850	.1625		
	15.0	.850	.1625		
	12.5	.850	.1625		
	10.0	.850	.1625	1.511	35.824
	7.5	.850	.1625		
	5.0	.850	.1625	1.202	35.817
1020	.33	.860	.1508	1.217	35.882

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 9Date: Nov. 29, 1974Euphotic Zone (m): 58.0

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1200	.33	.82	.1985	1.457	35.769
	5.0	.82	.1985	1.190	35.748
	7.5	.82	.1985		
	10.0	.82	.1985	1.484	35.756
	12.5	.82	.1985		
	15.0	.82	.1985		
	17.5	.83	.1863		
	20.0	.83	.1863	1.204	35.755
	25.0	.83	.1863		
	20.0	.83	.1863	1.204	35.755
	17.5	.83	.1863		
	15.0	.83	.1863		
	12.5	.83	.1863		
	10.0	.83	.1863	1.484	35.756
	7.5	.83	.1863		
	5.0	.83	.1863	1.190	35.740
1211	.33	.83	.1863	1.457	35.769

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

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TRANSMISSOMETER DATA WITH DEPTH

Location: Station 5Date: Nov. 29, 1974Euphotic Zone (m): 63.0

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1440	.33	.295	1.2208	2.178	27.345
	5.0	.300	1.2040	3.042	29.208
	7.5	.325	1.1239		
	10.0	.500	.6931	1.204	33.177
	12.5	.620	.4780		
	15.0	.630	.4620		
	17.5	.660	.4155		
	15.0	.660	.4155		
	12.5	.620	.4780		
	10.0	.570	.5621	1.204	33.177
	7.5	.340	1.0788		
	5.0	.290	1.2379	3.042	29.208
	.33	.280	1.2730	2.178	27.345

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 5 (R)Date: Nov. 30, 1974Euphotic Zone (m): 15.2ORIGINAL PAGE IS
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TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
0650	.33	.58	.5447	2.068	32.990
	5.0	.57	.5621	2.096	33.071
	7.5	.57	.5621		
	10.0	.58	.5447	1.537	33.173
	12.5	.58	.5447		
	15.0	.61	.4943		
	17.5	.67	.4005		
	20.0	.69	.3711	1.802	35.207
	17.5	.66	.4155		
	15.0	.60	.5108		
	12.5	.58	.5447		
	10.0	.56	.5798	1.537	33.173
	7.5	.56	.5798		
	5.0	.56	.5798	2.096	33.071
0706	.33	.56	.5798	2.068	32.990

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 6Date: Nov. 30, 1974Euphotic Zone (m): 30.0

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
0800	.33	.650	.4308	1.818	34.178
	5.0	.670	.4005	2.083	34.139
	7.5	.700	.3567		
	10.0	.740	.3011	1.469	35.417
	12.5	.810	.2107		
	15.0	.810	.2107		
	17.5	.830	.1863		
	20.0	.830	.1863	1.484	35.789
	17.5	.820	.1985		
	15.0	.805	.2169		
	12.5	.790	.2357		
	10.0	.760	.2744	1.469	35.417
	7.5	.690	.3711		
	5.0	.680	.3857	2.083	34.139
0810	.33	.660	.4155	1.818	34.178

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 8Date: Nov. 30, 1974Euphotic Zone (m): 45.0

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
0910	.33	.84	.1744	1.160	35.815
	5.0	.84	.1744	1.440	35.788
	7.5	.83	.1863		
	10.0	.83	.1863	1.415	35.780
	12.5	.83	.1863		
	15.0	.83	.1863		
	17.5	.83	.1863		
	20.0	.83	.1863	1.163	35.789
	17.5	.83	.1863		
	15.0	.83	.1863		
	12.5	.83	.1863		
	10.0	.83	.0863	1.415	35.780
	7.5	.83	.1863		
	5.0	.83	.1863	1.440	35.788
	.33	.83	.1863	1.160	35.815

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 7Date. Nov. 30, 1974Euphotic Zone (m): No Reading

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1020	.33	85.0	.1625	1.734	35.842
	5.0	--	--	1.480	35.804
	7.5	83.5	.1803		
	10.0	--	--	1.467	35.806
	Science stopped--weather became very dangerous.				

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 20Date. Dec. 20, 1974Euphotic Zone (m): 19.2ORIGINAL PAGE IS
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TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
0745	.33	.670	.4005	4.512	34.555
	5.0	.670	.4005	2.655	34.541
	7.5	.670	.4005		
	10.0	.665	.4080	2.965	34.577
	12.5	.665	.4080		
	15.0 -	.750	.2877		
	17.5	.830	.1863		
	20.0	.850	.1625	2.028	35.913
	17.5	.835	.1803		
	15.0	.710	.3425		
	12.5	.660	.4155		
	10.0	.655	.4231	2.965	34.577
	7.5	.650	.4308		
	5.0	.650	.4308	2.655	34.541
	.33	.650	.4308	4.512	34.555

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 21Date: Dec. 8, 1974Euphotic Zone (m): 48.0

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1020	.33	.865	.1450	2.254	35.932
	5.0	.865	.1450	1.163	35.890
	7.5	.860	.1508		
	10.0	.850	.1625	2.003	35.969
	12.5	.850	.1625		
	15.0	.845	.1684		
	17.5	.845	.1684		
	20.0	.845	.1684	1.709	35.961
	17.5	.845	.1684		
	15.0	.845	.1684		
	10.0	.850	.1625	2.003	35.969
	7.5	.850	.1625		
	5.0	.850	.1625	1.163	35.890
	.33	.850	.1625	2.254	35.932

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 22Date. Dec. 8, 1974Euphotic Zone (m): 15.2

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1320	.33	.520	.6539	8.438	33.061
	5.0	.520	.6539	4.123	33.054
	7.5	.520	.6539		
	10.0	.515	.6636	3.597	33.128
	12.5	.540	.6162		
	15.0	.565	.5709		
	17.5	.590	.5276		
	20.0	.600	.5108	1.857	33.874
	25.0	.670	.4005		
	20.0	.625	.4700	1.857	33.874
	17.5	.590	.5276		
	15.0	.570	.5621		
	12.5	.515	.6636		
	10.0	.510	.6733	3.597	33.128
	7.5	.510	.6733		
	5.0	.510	.6733	4.123	33.054
	.33	.510	.6733	8.438	33.061

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 23Date: Dec. 8, 1974Euphotic Zone (m): 13.8

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1555	.33	.505	.6832	6.603	32.567
	5.0	.505	.6832	7.191	32.563
	7.5	.510	.6733		
	10.0	.510	.6733	7.498	32.555
	12.5	.510	.6733		
	15.0	.510	.6733		
	17.5	.510	.6733		
	20.0	.425	.8557	1.228	35.252
	25.0	.305	1.1874		
	20.0	.310	1.1712	1.228	35.252
	17.5	.480	.7340		
	15.0	.510	.6733		
	12.5	.510	.6733		
	10.0	.510	.6733	7.498	32.555
	7.5	.500	.6931		
	5.0	.500	.6931	7.191	32.563
	.33	.500	.6931	6.603	32.567

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

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TRANSMISSOMETER DATA WITH DEPTH

Location: Station 24Date: Dec. 8, 1974Euphotic Zone (m): No Reading

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1812	.33	.30	1.2040	3.151	31.997
	5.0	.31	1.1712	4.924	31.933
	7.5	.31	1.1712		
	10.0	.31	1.1712	3.788	32.443
	12.5	.32	1.1394		
	15.0	.32	1.1394		
	17.5	.28	1.2730		
	15.0	.32	1.1394		
	12.5	.31	1.1712		
	10.0	.30	1.2040	3.788	32.443
	7.5	.30	1.2040		
	5.0	.30	1.2040	4.924	31.933
	.33	.30	1.2040	3.151	31.997

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 17Date: Dec. 8, 1974Euphotic Zone (m): No Reading

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
2020	.33	.515	.6636	5.096	33.585
	5.0	.515	.6636	12.286	33.569
	7.5	.510	.6733		
	10.0	.510	.6733	11.442	33.564
	12.5	.490	.7133		
	15.0	.490	.7133		
	17.5	.490	.7133		
	20.0	.360	1.0217		
	17.5	.440	.8210		
	15.0	.480	.7340		
	12.5	.490	.7133		
	10.0	.490	.7133	11.442	33.564
	7.5	.490	.7133		
	5.0	.495	.7032	12.286	33.569
	.33	.495	.7032	5.096	33.585

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 4Date: Dec. 9, 1974Euphotic Zone (m): 1.26

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
9040	.33	.310	1.1712	2.686	31.735
	5.0	.310	1.1712	3.326	32.740
	7.5	.310	1.1712		
	10.0	.305	1.1874	2.352	29.178
	12.5	.300	1.2040		
	15.0	.320	1.1394		
	17.5	.320	1.1394		
	20.0	.330	1.1087	1.204	35.172
	25.0	.330	1.1087		
	20.0	.330	1.1087	1.204	35.172
	17.5	.330	1.1087		
	15.0	.320	1.1394		
	12.5	.300	1.2040		
	10.0	.240	1.4271	2.352	29.178
	7.5	.280	1.2730		
	5.0	.280	1.2730	3.326	32.740
	.33	.280	1.2730	2.686	31.735

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 3Date: Dec. 9, 1974Euphotic Zone (m): 1.26

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1345	.33	.310	1.1712	4.161	21.786
	5.0	.310	1.1712	3.524	27.441
	7.5	.315	1.1552		
	10.0	.320	1.1394	2.352	31.747
	12.5	.325	1.1239		
	15.0	.301	1.2006	2.618	35.006
	17.5	.291	1.2344		
	20.0	.290	1.2379		
	17.5	.290	1.2379		
	15.0	.290	1.2379	2.618	35.006
	12.5	.300	1.2040		
	10.0	.320	1.1394	2.352	31.747
	7.5	.290	1.2379		
	.33	.280	1.2730	4.161	21.786

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

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TRANSMISSOMETER DATA WITH DEPTH

Location: Station 2Date: Dec. 9, 1974Euphotic Zone (m): 6.3

TIME	DEPTH (m)	%T	C (m^{-1})	Total Chlorophyll (mg/m^3)*	Salinity ‰
1530	.33	.330	1.1087	3.243	28.108
	5.0	.330	1.1087	2.671	29.373
	7.5	.330	1.1087		
	10.0	.330	1.1087	1.778	32.525
	12.5	.330	.9943		
	15.0	.400	.9163		
	17.5	.570	.5621		
	20.0	.610	.4943	1.482	35.486
	25.0	.650	.4308		
	20.0	.620	.4780	1.482	35.486
	17.5	.515	.6636		
	15.0	.470	.7550		
	12.5	.410	.8916		
	10.0	.340	1.0788	1.778	32.525
	7.5	.321	1.1363		
	5.0	.310	1.1712	2.671	29.373
	.33	.310	1.1712	3.243	28.108

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 1Date: Dec. 9, 1974Euphotic Zone (m): 6.3

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1440	.33	.340	1.0788	2.990	29.325
	5.0	.340	1.0788	3.032	29.684
	7.5	.340	1.0788		
	10.0	.340	1.0788	2.419	32.384
	12.5	.495	.7032		
	15.0	.510	.6733		
	17.5	.685	.3783		
	20.0	.730	.3147	3.089	35.416
	17.5	.685	.3783		
	15.0	.485	.7236		
	12.5	.480	.7340		
	10.0	.460	.7765	2.419	32.384
	7.5	.345	1.0642		
	5.0	.310	1.1712	3.032	29.684
	.33	.312	1.1648	2.990	29.325

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

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TRANSMISSOMETER DATA WITH DEPTH

Location: Station 9 (R)Date: Dec. 10, 1974Euphotic Zone (m): 45.0

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1200	.33	.720	.3285	1.846	35.015
	5.0	.720	.3285	1.511	35.058
	7.5	.725	.3216		
	10.0	.725	.3216	1.540	35.267
	12.5	.725	.3216		
	15.0	.730	.3147		
	17.5	.735	.3079		
	20.0	.770	.2614	1.511	35.693
	17.5	.745	.2944		
	15.0	.725	.3216		
	12.5	.720	.3285		
	10.0	.720	.3285	1.540	35.267
	7.5	.720	.3285		
	5.0	.720	.3285	1.511	35.058
	.33	.720	.3285	1.846	35.015

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 10 (R)Date: Dec. 10, 1974Euphotic Zone (m): 62.0

TIME	DEPTH (m) .	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1335	.33	.65	.4308	2.671	34.235
	5.0	.66	.4155	2.628	34.260
	7.5	.66	.4155		
	10.0	.66	.4155	2.671	34.457
	12.5	.66	.4155		
	15.0	.66	.4155		
	17.5	.71	.3425		
	20.0	.78	.2485	2.069	35.416
	17.5	.70	.3567		
	15.0	.66	.4155		
	12.5	.66	.4155		
	10.0	.65	.4308	2.671	34.457
	7.5	.65	.4308		
	5.0	.65	.4308	2.628	34.260
	.33	.65	.4308	2.671	34.235
* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.					

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 11 (R)ORIGINAL PAGE IS
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TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1430	.33	.600	.5108	2.655	33.464
	5.0	.605	.5025	2.390	33.459
	7.5	.610	.4943		
	10.0	.615	.4861	1.548	34.296
	12.5	.650	.4308		
	15.0	.715	.3355		
	17.5	.755	.2810		
	20.0	.755	.2810	1.215	35.326
	25.0	.755	.2810		
	20.0	.755	.2810	1.215	35.326
	17.5	.755	.2810		
	15.0	.710	.3425		
	12.5	.670	.4005		
	10.0	.630	.4620	1.548	34.296
	7.5	.605	.5025		
	5.0	.600	.5108	2.390	33.459
	.33	.600	.5108	2.655	33.464

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station 12 (R)Date: Dec. 10, 1974Euphotic Zone (m): 12.6

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1535	.33	.390	.9416	3.054	29.581
	5.0	.390	.9416	2.483	29.727
	7.5	.410	.8916		
	10.0	.450	.7985	1.506	31.313
	12.5	.480	.7340		
	15.0	.500	.6931		
	17.5	.540	.6162		
	20.0	.600	.5108	1.215	34.656
	17.5	.535	.6255		
	15.0	.510	.6733		
	12.5	.470	.7550		
	10.0	.460	.7765	1.506	31.313
	7.5	.420	.8675		
	5.0	.400	.9163	2.483	29.727
	.33	.380	.9676	3.054	29.581

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

LEG III
TRANSMISSOMETER DATA WITH DEPTH

Location: Station X

Date: Feb. 21, 1974

Euphotic Zone (m): _____

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1335	.33	.820	.1985	2.845	35.903
	7.5	.862	.1485		
	10.0	.882	.1256	3.152	36.934
	12.5	.895	.1109		
	10.0	.898	.1076	3.152	36.934
	7.5	.900	.1054		
	.33	.889	.1177	2.845	35.903

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* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station XIDate: Feb. 21, 1975

Euphotic Zone (m): _____

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1642	.33	.830	.1863	1.989	35.830
	7.5	.921	.0780		
	10.0	.920	.0834	0.853	35.823
	12.5	.918	.0856		
	13.5	.890	.1156		
	12.5	.910	.0943		
	10.0	.918	.0856	0.853	35.823
	7.5	.920	.0834		
	.33	.860	.1508	1.989	35.830
* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.					

TRANSMISSOMETER DATA WITH DEPTH

Location: Station XIIDate: Feb. 21, 1975

Euphotic Zone (m): _____

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity °/oo
0131	.33	.907	.0976	1.415	35.858
	2.5	.922	.0812		
	5.0	.926	.0769	1.457	35.846
	7.5	.925	.0780		
	10.0	.926	.0769	1.134	35.854
	12.5	.935	.0672		
	15.0	.935	.0672		
	17.5	.935	.0672		

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* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station XIIIDate: Feb. 22, 1975

Euphotic Zone (m): _____

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
0115	.33	.895	.1109	1.163	35.953
	2.5	.885	.1222		
	5.0	.884	.1233	1.149	35.951
	7.5	.892	.1143		
	10.0	.890	.1165	1.503	35.963
	12.5	.893	.1132		
	15.0	.892	.1143		
	17.5	.898	.1076		
	20.0	.898	.1076		
	17.5	.898	.1076		
	15.0	.892	.1143		
	12.5	.892	.1143		
	10.0	.893	.1132	1.503	35.963
	7.5	.895	.1109		
	5.0	.895	.1109	1.149	35.951
	2.5	.896	.1098		
	.33	.898	.1067	1.163	35.953

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

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TRANSMISSOMETER DATA WITH DEPTH

Location: Station XIVDate: Feb. 23, 1975

Euphotic Zone (m): _____

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
0117	.33	.85	.1625	1.134	35.977
	5.0	.89	.1165	1.185	35.998
	7.5	.90	.1054		
	10.0	.90	.1054	0.868	35.926
	12.5	.90	.1054		
	15.0	.90	.1054		
	17.5	.90	.1054		
	20.0	.90	.1054		
	22.5	.90	.1054		
	25.0	.90	.1054	1.121	36.041

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station XVIDate. Feb. 23, 1975

Euphotic Zone (m): _____

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1030	.33	.89	.1165	1.134	36.047
	2.5	.93	.0726		
	5.0	.94	.0619	1.134	35.985
	7.5	.95	.0513		
	10.0	.95	.0513	1.163	35.980
	12.5	.94	.0619		
	15.0	.94	.0619		
	17.5	.93	.0726		
	20.0	.93	.0726		
	17.5	.93	.0726		
	15.0	.94	.0619		
	12.5	.94	.0619		
	10.0	.95	.0513	1.163	35.980
	7.5	.93	.0726		
	5.0	.92	.0834	1.134	35.985
	2.5	.92	.0834		
	.33	.92	.0834	1.134	36.047

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* Chlorophylls a, b, and c are totaled exempting considerations of overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station XVIIDate: Feb. 23, 1975

Euphotic Zone (m): _____

TIME	DEPTH (m)	%T	C (m ⁻¹)	Total Chlorophyll' (mg/m ³)*	Salinity ‰
1255	.33	.80	.2231	1.709	35.990
	7.5	.85	.1625		
	10.0	.89	.1165	1.430	35.969
	12.5	.89	.1165		
	15.0	.89	.1165		
	17.5	.89	.1165		
	20.0	.89	.1165		
	17.5	.89	.1165		
	15.0	.89	.1165		
	12.5	.89	.1165		
	10.0	.89	.1165	1.430	35.969
	7.5	.89	.1165		
	.33	.89	.1165	1.709	35.990

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

TRANSMISSOMETER DATA WITH DEPTH

Location: Station XVIIIDate: Feb. 23, 1975

Euphotic Zone (m): _____

TIME	DEPTH (m)	%T	C(m ⁻¹)	Total Chlorophyll (mg/m ³)*	Salinity ‰
1500	.33	.83	.1863	1.695	35.045
	2.5	.85	.1625		
	5.0	.86	.1508	1.430	35.997
	7.5	.86	.1508		
	10.0	.86	.1508	1.723	36.023
	12.5	.86	.1508		
	15.0	.86	.1508		
	17.5	.86	.1508		
	20.0	.86	.1508		
	17.5	.86	.1508		
	15.0	.86	.1508		
	12.5	.86	.1508		
	10.0	.86	.1508	1.723	36.023
	7.5	.86	.1508		
	5.0	.86	.1508	1.430	35.997
	2.5	.86	.1508		
	.33	.86	.1508	1.695	35.045

* Chlorophylls a, b, and c are totaled exempting considerations for overlap between various spectral bands.

APPENDIX B

2°/90° SCATTERING METER DATA--INCIDENT PERCENT
TRANSMITTANCE, EXTINCTION COEFFICIENT, AND EUPHOTIC ZONE DATA

CALYPSO RESEARCH CRUISE OCT. 1974 - SEPT. 1975
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DATES OF THIS DATA

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$$VSF(2) = \frac{S(CAL)}{TR} \frac{SIG(2)}{S(SIG) REF(2)} m^{-1}$$

$$VSF(90) = \frac{S(CAL)}{TR} \frac{SIG(90)}{S(SIG) REF(90)} m^{-1}$$

$C = -\frac{1}{L} \ln T$
SW=SEA WATER
ISO=ISOTON

G=GAIN SETTING
S=SOURCE
READING

S(CAL)= 2.60

REF(2°)= 2.74G4

REF(90°)= .83G1

90° DETECTOR USED: ☒ LARGE ☐ SMALL

DAY	TIME		POSITION	SAMPLE	SIG(2)	SIG(90)	TR	S(SIG)	VSF(2) m ⁻¹	VSF(90) m ⁻¹	T %	1 m PATH	C m ⁻¹	SECCHI DEPTH IN METERS OR COMMENTS
	LOCAL	GMT												
8	0940		Miss. Plume Study Start Meas.	SW	2.28G2	.87G3	0	2.62	168	.445				90° slit out
	1000	1	Start Station 21	SW	1.75G3	.78G5	0	2.53	13.3897	.0041	.861	1	.1497	
	1056	2	End Sta. 21-Little Aft. Start to 22	SW	2.00G3	2.28-1.18 G5	0	2.48	15.6110	.0123- .0064	.861	1	.1497	
	1324	3	Long After Start of Station 22	SW	.46G2	.96G4	0	2.62	33.9867	.0491	.52	1	.6539	
	1340	4	End 22 Go To 23	SW	.64G2	1.80G4	0	2.75	45.0506	.0878	.52	1	.6539	
	1541	5	Start Station 23	SW	.49G2	1.36G4	0	2.71	35.0009	.0673	.505	1	.6832	
	1610	6	End 23 Go To 24	SW	.58G2	1.34G4	0	2.62	42.8528	.0686	.505	1	.6832	
	1800	7	Start Station 24	SW	.65G2	2.55-2.43 G4	0	2.45	51.3571	.1385- .1330	.30	1	1.2040	
	2115		Soon Aft End 17 Go To 4	SW			0							See Chart Paper for Numbers
	2215		Meter off to Calib	SW	.42G2	.89G4	0	2.52	32.2628	.0474				
9	1050	8	Little After Start of Station 4	SW	2.44G2	1.63G3	0	2.60	181.6642	.8405	.31	1	1.1712	
	1445	9	Long After Start of Station 3	SW	3.93G2	3.09G3	0	2.53	300.6942	1.6375	.31	1	1.1712	
	1505	10	End 3 Go To 2	SW	2.65G2	2.79G3	0	2.44	210.2369	1.5330	.31	1	1.1712	
	1528	11	Start Station 2	SW	2.20G2	.65G3	0	2.50	170.3474	.3486	.33	1	1.1087	
	1629	12	Start Station 1	SW	2.03G2	3.62G4	0	2.53	155.3204	.1918	.34	1	1.1088	
	1700		End 1 Go to Anch.	SW			0							See Chart Paper
	1757		Stop for Night An.	SW	1.61G2	3.01G4	0	2.29	136.0954	.1762				
	2047		Anchored	SW	2.20G2	2.87G4	0	2.52	168.9955	.1527				

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$$VSF(2) = \frac{S(CAL)}{TR} \frac{S(SIG)}{S(SIG)} \frac{SIG(2)}{REF(2)} m^{-1}$$

$$VSF(90) = \frac{S(CAL)}{TR} \frac{S(SIG)}{S(SIG)} \frac{SIG(90)}{REF(90)} m^{-1}$$

$C = -\frac{1}{L} \ln T$
SW = SEA WATER
ISO = ISOTON

G = GAIN SETTING
S = SOURCE READING

S(CAL) = 2.51 REF(2°) = 2.31G4 REF(90°) = .74G1 90° DETECTOR USED: ☒ LARGE ☐ SMALL

DAY	TIME		POSITION	SAMPLE	SIG(2)	SIG(90)	TR	S(SIG)	VSF(2) m ⁻¹	VSF(90) m ⁻¹	T %	1 m PATH	C m ⁻¹	SECCHI DEPTH IN METERS OR COMMENTS
	LOCAL	GMT												
13	0544			150			0							See Chart Paper
	0548			SW			0							See Chart Paper
	0638		Leave Anchorage E of Miss to oil rig	SW	1.88G3	.75G3	0	2.48	16.8034	.4390				
	0702			SW	2.02G3	.62G3	0	2.52	17.7682	.3572				
	0809			SW	1.48G3	3.14G3	0	2.72	12.0610	1.6759				
	0842			SW	.70G3	.95G4	0	2.46	6.3075	.0561				
	0925		Arrive at Oil Platform	SW	.92G3	.74G4	0	2.46	8.2898	.0437				
	1300		Leave Platform	SW	.90G3	.91G4	0	2.47	8.0768	.0535				See Chart Paper
	1315		Pump Off	SW			0							
	1346		Start to Contoy	SW			0							See Chart Paper
	1500			SW	.66G3	2.45G4	0	2.58	5.6704	.1424				
	2117			SW	.78G3	.6-1.2G4	0	2.68	6.4514	.0325- .0650				
14	0045			SW	.70G3	.50G4	0	2.58	6.0141	.0281				
	0746			SW	.70G3	.26G4	0	2.75	5.6423	.0137				
	1314			SW	.74G3	.72G4	0	2.61	6.2847	.0400				
	1633			SW	.62G3	.11-.16G4	0	2.48	5.5416	.0064- .0094				
	1740			SW	.62G3	.50-.90G5	0	2.45	5.6094	.0030- .0053				
	2055			SW	.72G3	.40-.80G5	0	2.46	6.4877	.0024- .0047				

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$VSF(2) = \frac{S(CAL)}{TR} \frac{S(SIG)}{S(SIG) REF(2)} m^{-1}$				$VSF(90) = \frac{S(CAL)}{TR} \frac{S(SIG)}{S(SIG) REF(90)} m^{-1}$				$C = -\frac{1}{L} \ln T$ SW=SEA WATER ISO=ISOTON		G=GAIN SETTING S=SOURCE READING				
S(CAL) = .86		REF(2°) = .69G3		REF(90°) = 1.56G1		90° DETECTOR USED: ☒ LARGE ☐ SMALL								
DAY	TIME		POSITION	SAMPLE	SIG(2)	SIG(90)	TR	S(SIG)	VSF(2) m ⁻¹	VSF(90) m ⁻¹	T %	1 m PATH	C m ⁻¹	SECCHI DEPTH IN METERS OR COMMENTS
	LOCAL	GMT												
21			Approaching Cozumel	Refs. Clean Cell			0	.86						
				ISO	.49G3	.40G5	0	.86	2040.82	.0011				
					.37G2	1.80G5	0	.87	270.27	.0049				
1334	17		Arrive Sta. X	SW	2.19G3	.70G	0	.61	456.62	.0027	.82	1	.1984	23.0
1409	18		Depart St. X	SW	3.01G3	1.31-1.52 G5	0	.60	332.23	.0052- .0060	.82	1	.1984	
1520			Enroute to Sta. XI	SW	2.12G3	.43- G5	0	.60	471.70	.0017- .0020				
1628			Arrive Sta. XI	SW	1.18G3	.40G5	0	.58	847.46	.0016	.83	1	.1863	> 35.0
1722	19		Depart Sta. XI	SW	1.77G3	.15- G5	0	.54	564.95	.0006- .0012	.83	1	.1863	
1837	20		Enroute to Sta. XII	SW	1.76G3	.21G5	0	.49	568.18	.0010				
1902			"	SW	1.72G3	.25- G5	0	.51	581.40	.0012- .0015				
2025			"	SW	1.74G3	.13- G5	0	.47	574.71	.0006- .0016				
2104			"	SW	1.84G3	.18- G5	0	.48	543.48	.0008- .0016				
2204			"	SW	1.63G3	.23G5	0	.40	613.50	.0014				
2310			Ship Mislocated	SW	2.06G3	.23- G5	0	.43	485.44	.0013- .0023				

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$$VSF(2) = \frac{S(CAL)}{TR} \frac{S(SIG)}{S(SIG) REF(2)} m^{-1}$$

$$VSF(90) = \frac{S(CAL)}{TR} \frac{S(SIG)}{S(SIG) REF(90)} m^{-1}$$

$C = -\frac{1}{L} \ln T$
SW=SEA WATER
ISO=ISOTON

G=GAIN SETTING
S=SOURCE READING

S(CAL) = .86 REF(2°) = .69G3 REF(90°) = 1.56G1 90° DETECTOR USED: ☒ LARGE ☐ SMALL

DAY	TIME		POSITION	SAMPLE	SIG(2)	SIG(90)	TR	S(SIG)	VSF(2) m ⁻¹	VSF(90) m ⁻¹	T %	1 m PATH	C m ⁻¹	SECCHI DEPTH IN METERS OR COMMENTS
	LOCAL	GMT												
22	0004		Enroute to Sta. XII	SW	1.58G3	.14-.22 G5	0	.46	8.73	.0002- .0011				
	0100	21	Arrive Sta. XII	SW	1.70G3	.05G5	0	.43	10.05	.0002	.907	1	.0976	Night
	0212	22	Depart Sta. XII	SW	1.84G3	.16-.23 G5	0	.49	9.55	.0007- .0011	.907	1	.0976	
	0304		Enroute to Sta. XIII	SW	1.66G3	.42G5	0	.43	9.82	.0023				
	0500		"	SW	1.57G3	.0-.02 G5	0	.41	9.74	0-.0001				
	0703		"	SW	1.76G3	.0-.03 G5	0	.47	9.52	0-.0002				
	0758		"	SW	1.72G3	0-.02G5	0	.49	8.93	0-.0001				
	0905	23	Arrive Sta. XIII	SW	.72G2	.60G4	0	.48	34.14	.0295	.895	1	.1109	31.0
	0910	24	at Sta. XIII	SW	2.05G3	1.02G5	0	.45	11.58	.0053	.895	1	.1109	
	9045	25	Depart Sta. XIII	SW	3.16G3	1.29G5	0	.51	15.75	.0060	.895	1	.1109	
	1059		Enroute to Sta. XIV	SW	2.26G3	.64G5	0	.48	11.97	.0031				
	1201		"	SW	2.32G3	.79G5	0	.55	10.73	.0034				
	1300		"	SW	2.04G3	.60G5	0	.48	10.81	.0029				
	1402		"	SW	2.29G3	.82G5	0	.50	11.65	.0039				
	1506		"	SW	2.22G3	.83G5	0	.49	11.52	.0040				
	1702		"	SW	2.28G2	3.61G4	0	.46	126.02	.1852				Water off, Wavy Pump Prob
	1736		"											Pump off, Too Wavy

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$$VSF(90) = \frac{S(CAL)}{S(SIG)} \frac{SIG(90)}{REF(90)} m^{-1}$$

$C = -\frac{1}{L} \ln T$
SW = SEA WATER
ISO = ISOTON

G= GAIN SETTING
S= SOURCE
READING

90° DETECTOR USED: ☒ LARGE ☐ SMALL

[illegible]

DATES OF THIS DATA
 Feb. 22, 1975

Feb. 22, 1975

$$C = -\frac{1}{L} \ln T$$

SW = SEA WATER
ISO = ISOTON

G = GAIN SETTING
S = SOURCE READING

90° DETECTOR USED: ☒ LARGE ☐ SMALL

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APPENDIX C
SUMMARY OF SURFACE MEASUREMENTS FOR LEGS I, II, AND III

SUMMARY OF SURFACE MEASUREMENTS COLLECTED DURING LEG I

Station	Date	Time	C -1 m	$\beta(2)$ -1 m	$\beta(90)$ -1 m	Dry Secchi (m)	Wet Secchi (m)	Salinity o/oo	Total Chloro (mg/m ³)	Euph Zone (m)
IA	9 Nov	0800-1000	--	NOT APPLICABLE		--	--	35.024	3.435	12.6
IB	9 Nov	1050-1213	--	IN LEG I		5.0	--	34.653	4.583	10.0
IIA	10 Nov	0800-0912	.3783			9.0	--	35.181	1.753	22.4
B	10 Nov	1007-1115	.4005			10.0	--	35.276	1.753	25.3
C	10 Nov	1201-1830	.4308			11.0	--	35.326	1.753	28.0
IIIA	13 Nov	0810-0915	.6051 (.6539)			4.0	5.0	34.243	2.846	10.0
B	13 Nov	1016-1112	.3567			12.0	14.0	34.375	1.709	30.0
C	13 Nov	1154-1830	.3901			10.0	13.0	34.525	1.989	25.3
IVA	15 Nov	0807-0920	.9467			3.0	3.3	33.464	1.989	7.6
B	15 Nov	1010-1115	.7444 (.7657)			4.0	4.5	33.829	1.989	10.0
C	15 Nov	1205-1300	.6694			5.0	6.0	34.461	2.003	13.6
VA	17 Nov	0747-0827	1.2658 (1.2765)			0.6	1.2	24.215	1.789	15.2
B	17 Nov	0903-0935	--			--	--	24.373	2.346	--
C	17 Nov	1528-1607	.8233 (.8074)			4.3	5.0	31.772	2.881	10.8

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SUMMARY OF SURFACE MEASUREMENTS COLLECTED DURING LEG I (cont.)

Station	Date	Time	C -1 m	$\beta(2)$ -1 m	$\beta(90)$ -1 m	Dry Secchi (m)	Wet Secchi (m)	Salinity ‰	Total Chloro (mg/m ³)	Euph Zone (m)
VIA	18 Nov	0820-0913	.2545 (.2332)	NOT APPLICABLE IN LEG I		14.0	22.0	34.640	0.587	25.0
B	18 Nov	1011-1110	.2640 (.1875)			17.0	22.2	34.194	1.134	42.6
C	18 Nov	1210-1258	.3581 (.2877)			15.0	18.3	34.316	1.147	38.0
IIA	19 Nov	1105-1215	.2653 (.2332)			20.0	25.0	35.384	1.121	50.4
B	19 Nov	1305-1400	.1625 (.1508)			18.0	27.8	36.009	0.840	45.0
C	19 Nov	1510-1640	.1672 (.1767)			30.0	28.75	35.990	0.853	76.0
IIA	20 Nov	0802-0855	.4005 (.3930)			10.0	14.6	33.657	1.427	25.3
B	20 Nov	1054-1202	.3188 (.2877)			11.4	12.3	34.562	1.721	28.6
C	20 Nov	1315-1403	.3079 (.3011)			10.0	12.0	34.602	1.161	25.3

SUMMARY OF SURFACE MEASUREMENTS COLLECTED DURING LEG II

(Before New Orelans)

Station	Date	Time	C -1 m	$\beta(2)$ -1 m	$\beta(90)$ -1 m	Dry Secchi (m)	Wet Secchi (m)	Salinity ‰	Total Chloro (mg/m ³)	Euph Zone (m)
A	26 Nov	2110-2215	.2614	NOT APPLICABLE ON THIS PART OF LEG II		--	--	34.990	2.037	--
B	27 Nov	0256-0635	.3567			--	--	33.531	2.340	--
C	27 Nov	1139-1330	.4277			9.5	8.5	33.486	3.990	24.0
16	28 Nov	0600-0709	.9808			2.0	3.5	28.364	2.655	5.0
15	28 Nov	0820-0910	.3711			10.0	11.7	35.580	1.202	25.3
14	28 Nov	1022-1110	.3350			8.25	10.75	35.493	1.747	20.8
13	28 Nov	1225-1330	.1567			34.0	43.5	35.808	1.163	85.0
19	28 Nov	1538-1610	.4308			7.25	9.0	35.649	2.083	18.6
18	28 Nov	1733-1810	.5361			--	--	35.348	1.774	--
12	29 Nov	0600-0658	.8916			--	--	30.772	2.403	--
11	29 Nov	0805-0848	.2107			--	--	35.933	2.016	--
10	29 Nov	0945-1031	.1335			34.5	--	35.882	1.217	62.0
9	29 Nov	1135-1215	.1985			23.0	--	35.769	1.457	58.0
5	29 Nov	1402-1500	1.2208			25.0	--	27.345	2.178	63.0
5(R)	30 Nov	0634-0713	.5447			6.0	--	32.990	2.068	15.2
6	30 Nov	0745-0815	.4308			12.0	--	34.178	1.818	30.0
8	30 Nov	0850-0936	.1744			18.0	--	35.815	1.160	45.0
7	30 Nov	1003-1028	.1625			--	--	35.842	1.734	--

SUMMARY OF SURFACE MEASUREMENTS COLLECTED DURING LEG II

(After New Orleans)

Station	Date	Time	C -1 m	$\beta(2)$ -1 m	$\beta(90)$ -1 m	Dry Secchi (m)	Wet Secchi (m)	Salinity ‰	Total Chloro (mg/m ³)	Euph Zone (m)
20	8 Dec	0710-0810	.4005			7.5	--	34.555	4.512	19.2
21	8 Dec	1000-1047	.1450	13.3897 (15.6110)	.0041 (.0123-.0064)	19.0	--	35.932	2.254	48.0
22	8 Dec	1308-1338	.6539	33.9867 (45.0506)	.0491 (.0878)	6.0	--	33.061	8.438	15.2
23	8 Dec	1538-1604	.6832	35.0009 (42.8528)	.0673 (.0686)	5.5	--	32.567	6.603	13.8
24	8 Dec	1800-1820	1.2040	51.3571	.1385-.1330	--	--	31.997	3.151	--
17	8 Dec	2010-2053	.6636	--	--	--	--	33.585	5.096	--
	9 Dec	0930- --	1.1712	181.6642	.8405	0.5	--	31.735	2.686	1.26
3	9 Dec	1320- --	1.1712	300.6942 (210.2369)	1.6375 (1.5330)	0.5	--	21.786	4.161	1.26
2	9 Dec	1502-1544	1.1087	170.3474	.3486	2.5	--	28.108	3.243	6.3
	9 Dec	1620-1655	1.0788	155.3204	.1918	2.5	--	29.325	2.990	6.3
9(R)	10 Dec	1142-1210	.3285	231.9847 (218.9519)	.0484 (.0412)	18.0	17.0	35.015	1.846	45.0
10(R)	10 Dec	1320-1348	.4308	247.6320	.0896	12.0	11.0	34.235	2.671	62.0
11(R)	10 Dec	1421-1447	.5108	239.5967	.0511	9.0	10.0	33.464	2.655	22.4
12(R)	10 Dec	1526-1545	.9416	--	--	5.0	--	29.581	3.054	12.6

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SUMMARY OF SURFACE MEASUREMENTS COLLECTED DURING LEG III

Station	Date	Time	C -1 m	$\beta(2)$ -1 m	$\beta(90)$ -1 m	Dry Secchi (m)	Wet Secchi (m)	Salinity ‰	Total Chloro (mg/m ³)	Euph Zone (m)
X	21 Feb	1327-1407	.1985 (.1177)	456.62 (332.23)	.0027 (.0052-.0060)	23.0	--	35.903	2.845	58.0
XI	21 Feb	1630-1722	.1863 (.1508)	847.46 (564.95)	.0016 (.0006-.0012)	>35.0	--	35.830	1.989	>88.0
XII	21 Feb	0112-0212	.0976	10.05 (9.55)	.0002 (.0007-.0011)	--	--	35.858	1.415	--
XIII	22 Feb	0908-0945	.1109 (.1067)	38.14 (11.58) (15.75)	.0295 (.0053) (.0060)	31.0	--	35.953	1.163	78.0
XIV	23 Feb	0102-0140	.1625 (.1054)	-- (2.32)	-- (.006)	--	--	35.977	1.134	--
XV	23 Feb	0622-0657	Too Rough	--	--	--	--	36.010	0.870	--
XVI	23 Feb	1000-1040	.1165 (.0834)	--	--	32.0	--	36.047	1.134	80.0
XVII	23 Feb	1232-1300	.2231 (.1165)	4.03 (4.24)	.0155 (.0150)	30.0	--	35.990	1.709	76.0
XVIII	23 Feb	1449-1503	.1863 (.1508)	10.98 (4.31)	.0253 (.0086)	27.0	--	35.045	1.695	68.0